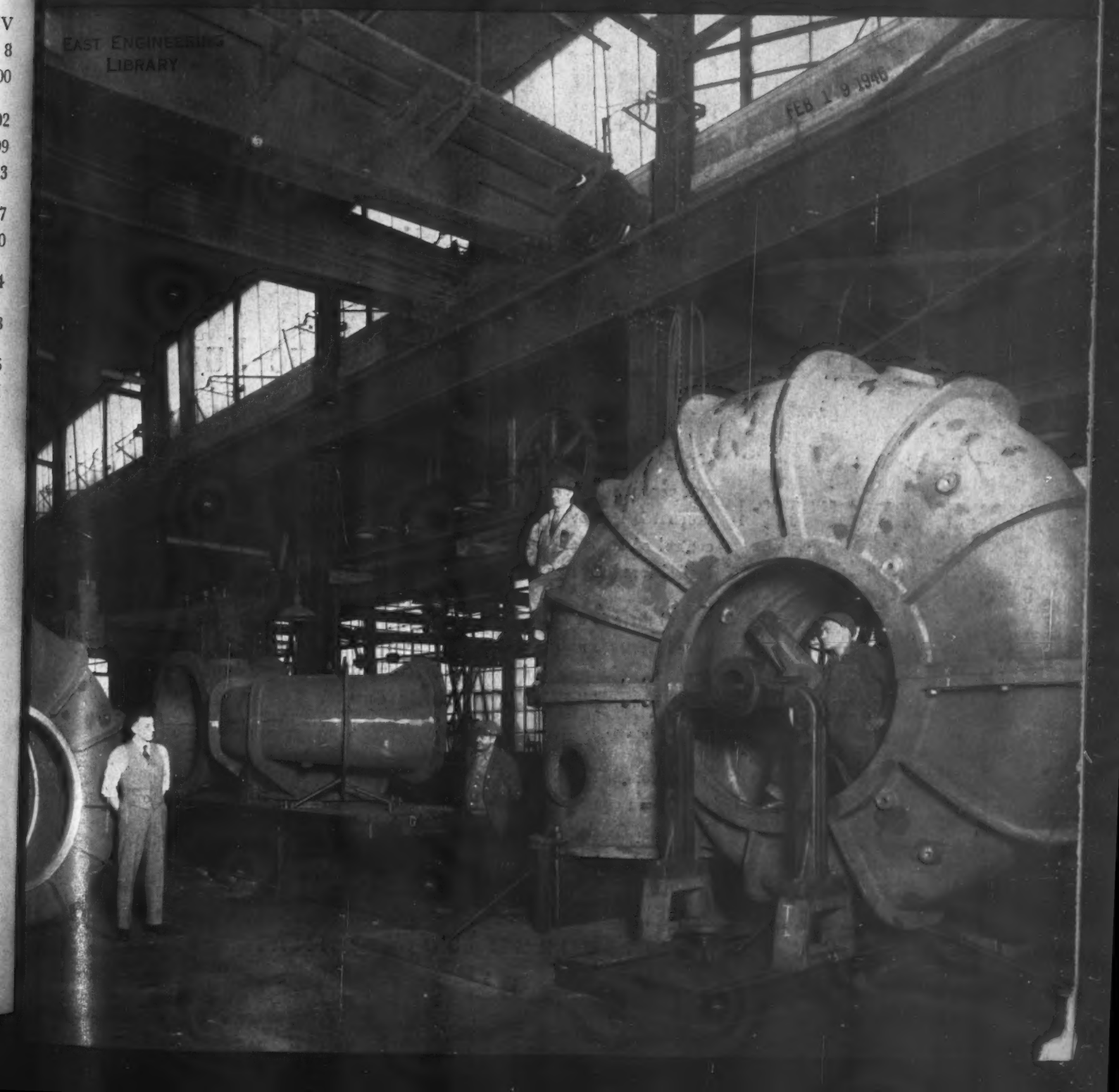
American Foundryman

★ THE FOUNDRYMEN'S OWN MAGAZINE



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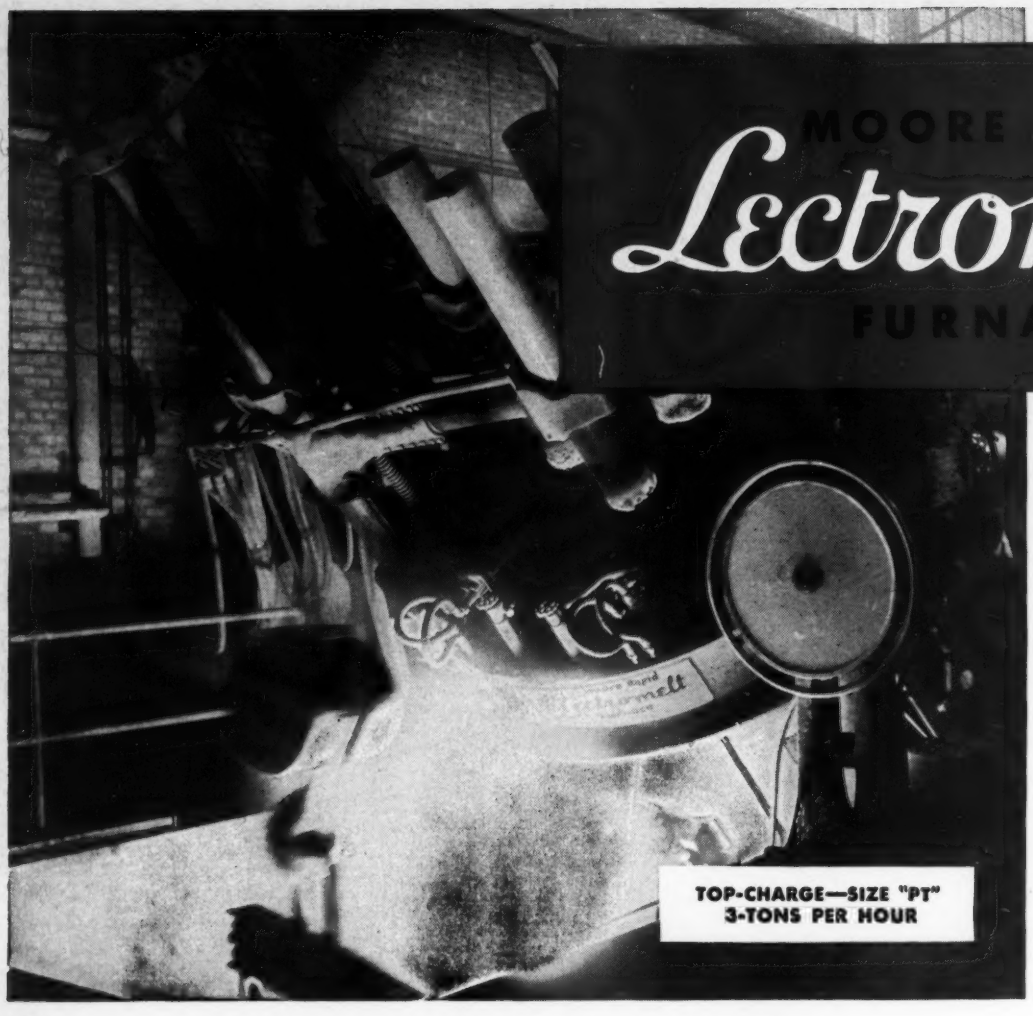

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Large pump housings (Fig. 8, p. 35, this issue) were made from skeleton patterns which were destroyed after job completion. Skeleton pattern was so constructed that core could be made in the mold and lifted out with arbor for finishing and drying.

A. F. A.

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★ FEBRUARY WHO'S WHO ★

Steven G. Garry

Author of the current article on *"Engineer of Human Relations,"* Mr. Garry has served as general foreman of the foundry division, Caterpillar Tractor Co., Peoria, Ill., since 1930... Born in Muskegon, Mich., he entered the foundry business with Lakey Foundry & Machine Co., Inc., Muskegon, as a coremaker in 1926 . . . Moved to Campbell Wyant & Cannon Foundry Co. in 1928 . . . Author of papers on aluminum and magnesium and on foreman training problems . . . Vice-chairman of the Foreman Training Committee . . . Has presented a number of talks before A.F.A. chapters on employee relations.

Committee Report

See Report of Committee on Casting Stability, Aluminum Magnesium Division . . . Committee members are: Chairman, Hiram Brown, Aluminum Industries, Inc., Cincinnati; G. H. Starmann, Apex Smelting Co., Chicago; H. J. Rowe, Aluminum Co. of America, Cleveland; R. E. Ward, Eclipse Pioneer Div., Bendix Aviation Corp., Bendix, N. J.

Arthur J. Tuscany

Executive Secretary and Treasurer of Foundry Equipment Manufacturers Association, Inc., Cleveland... Continuously associated with trade association work within the foundry industry since 1922 ...In that year became Executive Secretary, Ohio Foundrymen's Association, where he played active part in developing a standard sales agreement and trade customs still used today... Called to Gray Iron Institute in 1928 as Manager... Established cost bureau to further principles of gray iron cost finding and merchandising in step with new developments in gray iron... In 1935 established own office as Trade Association Consultant and advisor to a selected group of trade associations, including F.E.M.A.... A member of A.F.A. since 1923, has long been closely associated with foundry problems... Well known as a speaker before A.F.A. chapters and other groups connected with castings industry... Now active in educational work of F.E.M.A., one phase described in paper in this issue, *"Foundry Industry and Educational Institutions."*

A. C. Den Breejen

The author of *"Microscope and Camera in the Study of Foundry Sands"* is associated with Hydro-Blast Corp., Chicago, as a foundry sand technician . . . Native of Amsterdam, Holland . . . Mr. Den Breejen received early technical training at Armour Institute of Technology, Chicago, now Illinois Institute of Technology . . . Began foundry work as molding apprentice with W. A. Jones Foundry & Machine Co., Chicago . . . Completed apprenticeship with Nichol-Straight Foundry Co., Chicago, 1933-34 . . . Practical molding experience with Nichol-Straight, Oklahoma Brass & Iron Co., and Ferguson & Lange Foundries, Inc. . . . Foundry instructor at University of Minnesota, 1938-39 . . . Foundry superintendent with Perfection Mfg. Corp., Minneapolis, before associating with Hydro-Blast Corp. . . . A popular speaker before many A.F.A. chapters on sand reclamation and kindred subjects . . . Member of Committee on Sand Grading and Fineness.

Sam Belus

See a practical paper in this issue on *"Necked-down Risers,"* authored by Mr. Belus . . . Early schooling received in Chicago and Milwaukee Vocational Schools... Entered the casting industry as a patternmaker with Hubbard Steel Foundries, Chicago, in 1926 . . . Three years later became chief inspector at Wehr Steel Co., Milwaukee . . . Now holds the same position with Burnside Steel Foundry Co., Chicago, having been connected with that company since 1934.

D. C. Williams

Mr. Williams presents in this issue the *"5th Progress Report"* of his research work on Elevated Temperature Properties of Sand... An A.F.A. Fellow at Cornell University, Mr. Williams is conducting this research under the A.F.A. Technical Development Program . . . A native of Illinois, and a graduate of Beloit College, Beloit, Wis. (1930) with a B.S. degree . . . Entered industry as a chemist with E. I. Du Pont de Nemours & Co., Wilmington, Del. . . . Served as chemist with J. R. Short Milling Co., Chicago . . . Heating and air conditioning engineer with Delco-Frigidaire Div., General Motors Corp., 1937 . . . chemical engineer, Research Laboratory, American Steel Foundries, East Chicago, Ind., 1937-43 . . . His present research work holds great possibilities for discovery of new facts concerning the behavior of sands at elevated temperatures.

C. F. Rohlkoetter

This native of St. Louis presents herein a paper on *"Inspection of Steel Castings"* . . . Educated in St. Louis public schools and at Washington University there . . . Began industrial career as material inspector with Missouri Pacific Ry., Southern Ry. and Union Pacific R.R. Entered the foundry industry in 1936 and associated continuously ever since with American Steel Foundries, East St. Louis, Ill. . . . Successively promoted from assistant general foreman to chief inspector, to general foreman, his present capacity . . . Has presented papers on inspection of steel castings before A.F.A.

conventions . . . Member of A.F.A., St. Louis Ordnance Association and the Car Department Association of St. Louis.

W. W. Levi

"Wally" Levi, born at Ann Arbor, Mich., in 1902 . . . Graduated in chemical engineering from University of Michigan (1920-26) . . . Postgraduate study in Europe at Special School of Public Works, in Paris, France . . . From 1926-34, connected with Deere & Co., Moline, Ill., in metallurgical laboratory . . . Moved to Waterloo, Iowa, plant of Deere organization, remaining there until 1934 . . . Since that time, Chief Metallurgist, Lynchburg Foundry Co., Lynchburg, Va. . . . Active in Cupola Research Project of A.F.A. and has addressed a number of chapters on gray iron foundry subjects . . . Author of article on *"Cupola Operation and Control,"* in current issue.

William C. Maxwell

Author of paper in this issue on *"Patterns in the Jobbing Foundry"* . . . Formerly Superintendent of Fulton Foundry & Machine Co., Cleveland . . . Recently formed his own company, the M. B. M. Foundry Co. in Cleveland, of which he is President and General Manager . . . "Scotty" has been an active member of the Northeastern Ohio Chapter.

DISCUSSION WANTED!

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The men who are recognized on these Who's Who pages each month have spent considerable time and effort in preparing their papers for presentation herein, and the value of their findings can be materially enhanced through discussion. Since oral discussion of these papers is not possible this year, written discussion is earnestly solicited!

Members of A.F.A. owe it to these authors to take a definite interest in their work. Written discussion should be forwarded direct to A.F.A. headquarters in Chicago, for publication in future issues of *American Foundryman*.

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50th ANNIVERSARY

A DECISIVE YEAR

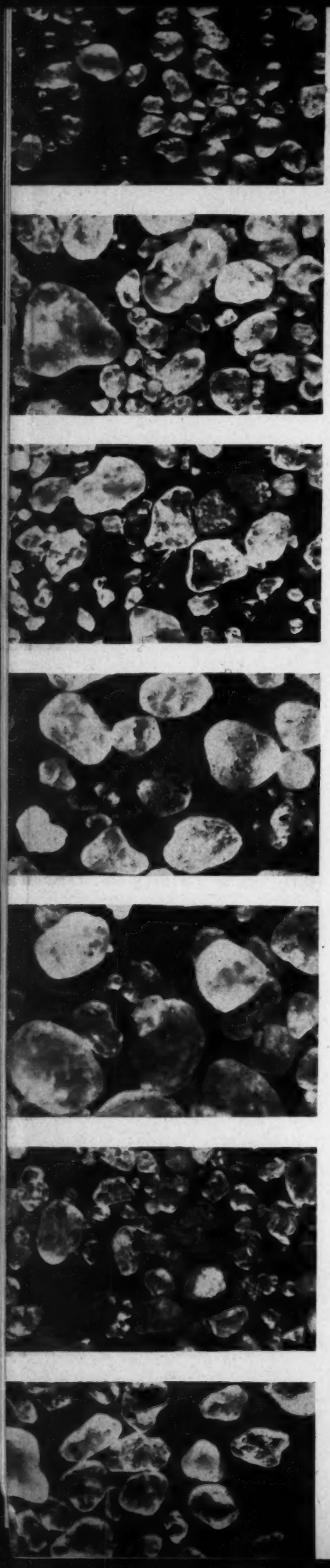
IT SOMETIMES HAPPENS that between the birth of an idea in the minds of men, and the full fruition of their thoughts, scores of years may elapse. Such growth may indeed appear slow to some, but invariably it brings with it something sound, something deep-rooted and lasting —something that the passage of time has proved to be of lasting value to everyone who shares in its growth.

This year the American Foundrymen's Association celebrates its 50th year of service to a great industry, an industry so basic and so vital to all other industrial pursuits that to be deprived of castings would mean that civilization would be deprived of progress. A single organization would be presumptuous indeed to claim all credit for the advancements made within a full half century in the field it represents.

It is men, not an organization, who bring about progress, and it is the men of A.F.A. who have advanced this industry by their unselfish and intelligent activities through the framework of this Association.

This 50th Anniversary year of A.F.A. is a decisive year for foundrymen. Reconversion, new markets and new processes all affect the picture and the industry as a whole finds it necessary to rebuild its stature in the eyes of the general public from which it draws its manpower. Into this picture A.F.A. will project in May an event that has served the industry well for a full half century, and the industry will not be slow to recognize its value in the solution of its problems.

Your Association's activities in this 50th Anniversary year are built around those problems and dedicated to finding means for solving them. The 1946 Convention and Exhibit, a National Educational Program, increased work of vital committees, publications of practical and technical worth, acceleration of the Technical Development Program and the AMERICAN FOUNDRYMAN in its present bright new form—these are some of the media by which A.F.A. is prepared to do its part in the next half century as it has in the one now passing.



MICROSCOPE AND CAMERA

in the study of FOUNDRY SAND

A. C. Den Breejen
Sand Technician
Hydro-Blast Corp.
Chicago

USE OF THE MICROSCOPE and camera in connection with various divisions of scientific and industrial work is rapidly increasing. Their use has greatly increased the wealth of knowledge in such fields as medicine, chemistry, biology and metallurgy, and has given the workers in these fields new tools with which to work and a means to permanently record their findings.

The sand laboratory of the average foundry, however, has not fully realized the importance of these tools, or has been diverted from their full usage due to an erroneous conception that complicated and costly equipment is necessary and that a high degree of technical knowledge of optics, chemistry and photography is required to produce satisfactory results. Nothing could be further from the truth! If a man can take a picture with a hand camera, follow the printed directions on a package of photographic chemicals, and if his company will spend $150 to $200 he will have the requirements and tools to begin work.

The investment on the part of the company is one it will never regret. It will pay for itself tenfold in the many applications in which it can be employed usefully. The following article, in answer to numerous requests from sand technicians, laboratory workers and sand

Fig. 7—Photomicrographs of new sand at 25 diameters (from top to bottom):

Small grains but variation in size not great.

Note low clay content present and variation in size of grains.

Fragmentary particles present.

Conglomerate grains present in this bank sand.

New washed sand.

Darker grains contain appreciable amounts of iron oxide as part of the silica make-up.

Note light clay splotches.

Foundry sand laboratories, in general, have overlooked the possibilities offered by microscope and camera . . . simple, inexpensive tools . . . for study of a basic metal — casting material . . . foundry sand.

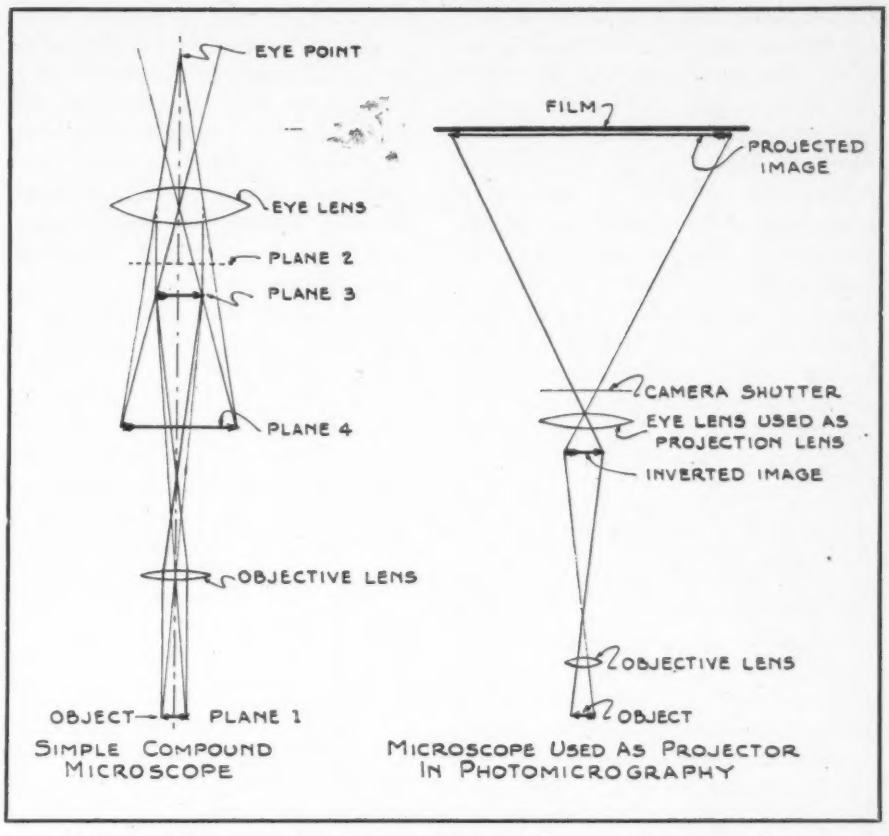


Fig. 1—Diagrams showing principles of simple compound microscope and its use with camera in photomicrography.

users, will be written with a viewpoint to simplicity, as directly to the point as possible and as informative as is consistent with the actual requirements needed to produce satisfactory results. Readers who wish to delve deeper into the subject will find a reference list of publications at the end of this article.

The microscope used in the visual examination of foundry sands need not differ greatly from that used in the botany and zoology classes in high schools. Microscopes

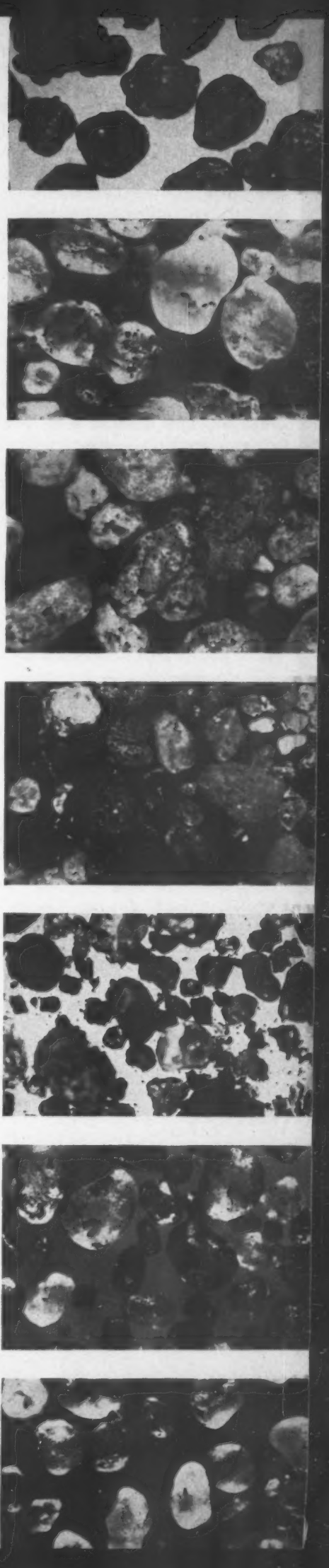


Fig. 8—Photomicrographs of sands at 25 diameters (top to bottom):

Used core sand. Note carbonized oil coating on grains.

Reclaimed core sand. Surface of grains and crevices plugged with carbonized or oxidized oil not wholly removed.

Ignited refuse sand. Spongy clay coating on grains partially calcined.

Used molding sand. Clay coating on grains and some black, shiny grains from core sand contamination.

Discarded molding sand. Note presence of fines and graphite-clay coatings on grains.

Used core sand. Note appearance of some almost clean grains showing result of improper mixing or removal of oil film by heat in proximity of core-metal interface.

Reclaimed core sand showing presence of some oxidized and carbonized oil on some grains.

such as those given to youngsters as Christmas presents could be used, although instruments can be purchased for a few dollars more at medical school equipment houses, pawnbrokers and secondhand stores, with far better results and greater satisfaction in both visual inspection and photomicrography. A simple compound microscope, which can be purchased secondhand (with 1-2 objective lenses and eyepieces) for perhaps $100, is entirely satisfactory if the purchaser is willing to forego such conveniences as a mechanical stage, substage filter glass carrier, turret-type objective nosepiece, and sacrifice a little insofar as the flatness of the field is concerned.

Simple Equipment Sufficient. Most work on foundry sands is done at less than 50 diameter magnification and will require a 32 or 48 millimeter objective lens and perhaps 5×, 7.5× and 10× eyepieces. These combinations will give magnifications up to 50 diameters and, for most purposes in foundry sand study, will be ample. The author does not wish to convey the idea that the least expensive equipment should be purchased, but it is foolish to buy equipment such as is required when doing work at 500 or 1000 diameters or higher. Any reputable optical equipment dealer can and will help in the selection of the appropriate equipment. If $500 or more has been allotted for photomicrographic equipment, by all means buy the best, as the only criteria of what to buy are (a) will it do the job required and (b) does it fit the budget?

How a Microscope Works. The compound microscope, as it is termed in textbooks on optics, consists essentially of two parts, the objective lens and the eyepiece. As illustrated in Fig. 1, the objective lens (the lens on the lower end of the body tube) will form a real but inverted image of the object being examined at plane 1 in plane 2, but the field lens of the eyepiece intercepts the rays forming the image on plane 3. The image is examined with the eye lens, which acts as a magnifier forming a virtual image at plane 4. Thus the object undergoes two stages of magnification—first by the objective lens and the second by the eyepiece. Therefore, the magnifying power of the microscope is the product of the power of magnification of the objective lens times the magnifying power of the eyepiece.

Magnifying Power of Objective × *Magnifying Power of Eyepiece* = *Magnifying Power of Microscope*

At this point one might be led to believe that by making the eyepiece high enough in magnifying power an unlimited degree of magnification might be obtained, but this is not true and would lead to complications. The basic reasons underlying this failure are due to the structure of the objective lens and of light itself. However, since the microscopic study of sand is carried out at low magnification, these difficulties encountered in high magnification work will not be discussed here.

Microscope Parts. Our microscope consists of the following easily identified parts: foot piece and supports, arm, body tube, draw tube, stage, eyepiece and objective, fine and coarse adjustment knobs and rack.

Assuming that the best microscope that the budget will permit has been obtained, the operator now is ready to put it to use in the examination of foundry sands. Perhaps the microscope has a mirror and substage condensor. These are useful in the examination of materials that are transparent or nearly so, in which case the light rays from a light source can be caught by the mirror, "squeezed" or condensed to a small beam by means of the substage condensor and passed through the specimen as a concentrated brilliant light. This, however, is not so with foundry sand which ranges from a dense black crystal to a milky or almost transparent color. For the present, let us forget the mirror and substage condensor, and swing it over to the side until such time as it is needed. Now to begin work.

Preparation of Sample and Focusing. Obtain a sample of new sand

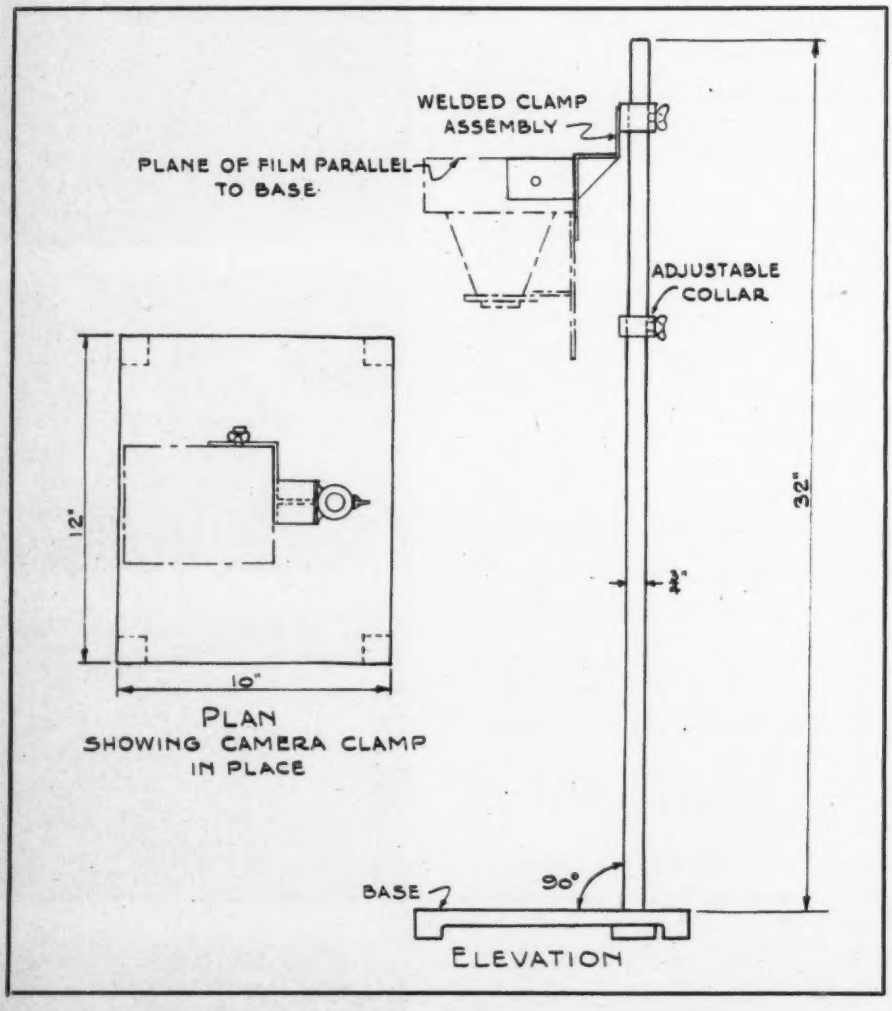


Fig. 2—Sketch of base and stand for microscope and camera.

(a pinch will do) and spread it evenly with a spatula over the surface of a glass microscope slide and place the slide on the stage. Tap the slide gently to arrange the grains in a layer "one-grain" thick. (Use the microscope near a window to get sufficient light, or place a desk light near the stage to obtain the desired degree of illumination.) Use a 5× eyepiece and 32 mm. objective lens in the microscope, pull out the draw tube to the length recommended by the manufacturer (usually 160 mm.) and turn the coarse adjustment until the objective lens is somewhere near 1¾-in. from the specimen. Carefully raise or lower the body tube of the microscope by the adjustment knobs until the object is in focus.

If the variation in size of the sand grains is not too great, it should be possible to get almost all of the grains in sharp focus. If it is not possible to get most of the grains in focus, too high a magnifier in the eyepiece or in the objective lens is being used. In the visual observation of any object when the magnification is raised, these basic conditions and limitations must be kept in mind: (a) the working distance between specimen and objective lens is decreased; (b) the depth of focus is decreased (that is, the depth at which the entire object will be in sharp focus); (c) the size of the field which can be observed is decreased. These limitations, in general, are not met in working with magnifications up to approximately 30 diameters, but offer special problems in illumination and technique in observation and photography when working at higher magnifications.

Appearance of Sand Grains. Now that the sand grains are in focus, what is seen? The red splotch on that white sand grain is probably a dab of clay or iron oxide. The light brown grain is probably a silica grain stained through and through with iron, much as glass is colored and stained by impurities present. Notice the surface of the grains. They are not smooth like marbles and not perfectly round as the observer might have imagined them to be. Note also that some grains have cracks and fissures in them. Those grains probably will break down into dust on being used a couple of times in contact with hot metal or may break in mulling or handling by the sand conveying system or sand slinger.

Look at a sample of used core sand from the core knockout or a sample from the molding sand heap. A considerable change from what the new sand looked like is noted. Some grains are almost pure black, others are colored a dark brown, some have a spongy coating of burned clay or cereal binder on them, and still others are almost like new. The observer probably will find a considerable portion of very minute particles present, some of which sparkle like gems while others do not. The shiny particles probably are fine particles of silica that have been broken down from larger grains that were inherently weak; the dull particles are probably particles of sea coal, clay, burned-out pitch or other organic matter. The black grains from the core knockout probably are covered with carbon from the carbonized oil, the dark brown grains are oxidized oil coatings that have not been as completely carbonized.

Microscope Helps to Solve Sand Problem. Here is the beginning of a fascinating and instructive field of study! Here is a new tool with which to study any number of sand problems! It will help to answer such questions as: "How well does the sand we use stand up under usage?; how well does the mixer recondition the sand?; are we thoroughly mixing our ingredients?; are we completely covering our sand grains with the clay that we are adding, or are we just putting big splotches of clay unevenly through our sand?; is our sand really 'burning-on' to the castings or is our sand so open that we are getting metal penetration?" These questions and many others can be answered by the use of the microscope and a permanent record made of the findings for future reference. The interpretation of what has been observed in using the microscope is not difficult and the more the equipment is used, the more rapidly can the observer interpretrate what he sees.

Illumination

Once the thrill of the first few sand examinations has worn off, the observer is ready to consider seriously his sand investigations and, as an outcome of this, he will desire, in all probability, to record photographically what he has observed through the microscope.

There are many days when there is insufficient light coming from a nearby window to make visual observation and photography entirely satisfactory. To eliminate the variations in light on bright and cloudy days, lighting should be standardized. If the observer used a desk lamp in his initial trial with the microscope, he was on the right path to controlled illumination. The author has found it highly satisfactory to emply two desks lamps of the gooseneck type (one on each side of the microscope) to illuminate the specimen under observation. Two 100-watt bulbs, either of the daylight or frosted type, are used for visual observation or for "black and white" photography. The same setup is used for color photography with Kodachrome film, but the 100-watt bulbs are replaced with No. 1 photoflood lamps which yield light of sufficient intensity for this work (light temperature emitted from the No. 1 photoflood lamps is approximately 3300° Kelvin or 3027° C. or 5480.6° F.).

Construction of Photographic Unit. To make a sturdy, compact unit to handle both visual and photographic work, it is advisable to construct a unit such as shown in Fig. 2. The base upon which the microscope rests is a gray iron casting 10 in. by 12 in. and machined to a smooth flat surface, drilled and tapped to accommodate the perpendicular upright support (used for holding the camera above the eyepiece of the microscope when photomicrographs are being made). The upright support must be absolutely perpendicular to the base upon which the microscope rests and the camera support made perpendicular to the upright support. This, simply expressed, means that the plane of the film used in the camera must be parallel to the plane of the microscope stage, or any pictures taken will be distorted. When the camera is not being used, it can be swung out of the way and will not interfere with visual examination.

The lights used for illumination of the specimen need not be an integral part of the camera-microscope stand and can, therefore, be adjusted to give the most satisfactory illumination for any particular study. The microscope and camera stand, when

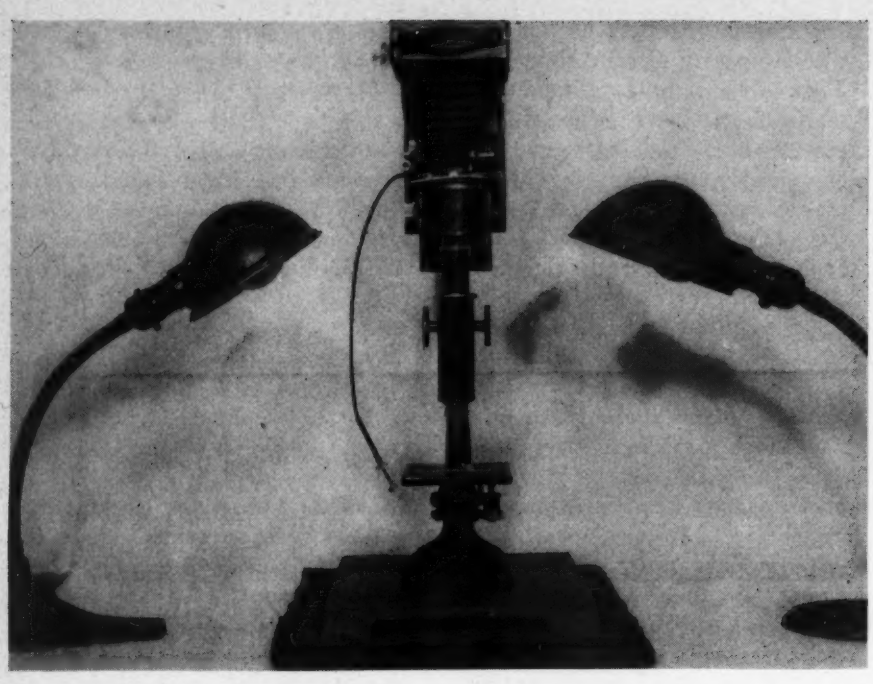


Fig. 3—Photomicrographic set-up showing placement of camera, lights, and microscope. Unit ready for exposure.

constructed as mentioned, then is placed on sponge rubber. This is a precaution against vibration of the unit by local disturbances. Using such a precaution, if the unit is affected by vibrations it will vibrate as a unit.

The Camera

If the reader is not interested in photographically recording what he has observed through the use of the microscope in the study of foundry sand, the following perhaps will be of little interest to him.

In the choice of cameras for photomicrography of foundry sands, there is as much choice as there is in the selection of a suitable microscope for visual examination. At this point, it may be well to state that the simplest camera to use is in reality not a camera at all as a camera lens is not required. In reality, it is a light-tight box at one end of which there is a shutter to admit light at will and at the other end provision is made for placing a piece of ground glass or photographic film. The author experimented a great deal with various cameras, finally coming to the conclusion that all that is necessary for satisfactory results is the aforementioned arrangement.

A folding camera, having either single or double extension bellows, equipped with a ground glass back and plate holders or film pack adapter is a very satisfactory arrangement. *No lens is required* as the eyepiece lens of the microscope is used as a projection lens, projecting the image onto the ground glass or film. Cameras of this type are not difficult to find and, since no lens is required, can be purchased for considerably less than the price paid by many amateur photographers using these cameras for general photographic art.

The author uses a Kodak Recomar No. 33 camera in his setup, which was equipped with a F 4.5 anastigmatic lens, film pack adapter, three cut film holders and cable shutter release, and purchased for the sum of $45. Such a camera is most useful. When it is needed for shop pictures of equipment, experimental setups, etc., the lenses are inserted and the required pictures made; when it is required for photomicrographic work, it can be adapted quickly to that field of work by simply removing the lenses. If one wishes to spend considerably more than this for a camera, the Leitz, Zeiss, Spencer, and Bausch & Lomb companies all have equipment to suit the taste and purse. Complete photomicrographic equipment units also can be obtained from these companies. However, large, expensive photographic units are outside the scope of this paper, which is written specifically for individuals and companies which have a limited amount of money to spend.

Photomicrography

The word "photomicrograph" is composed of the two words "photo"

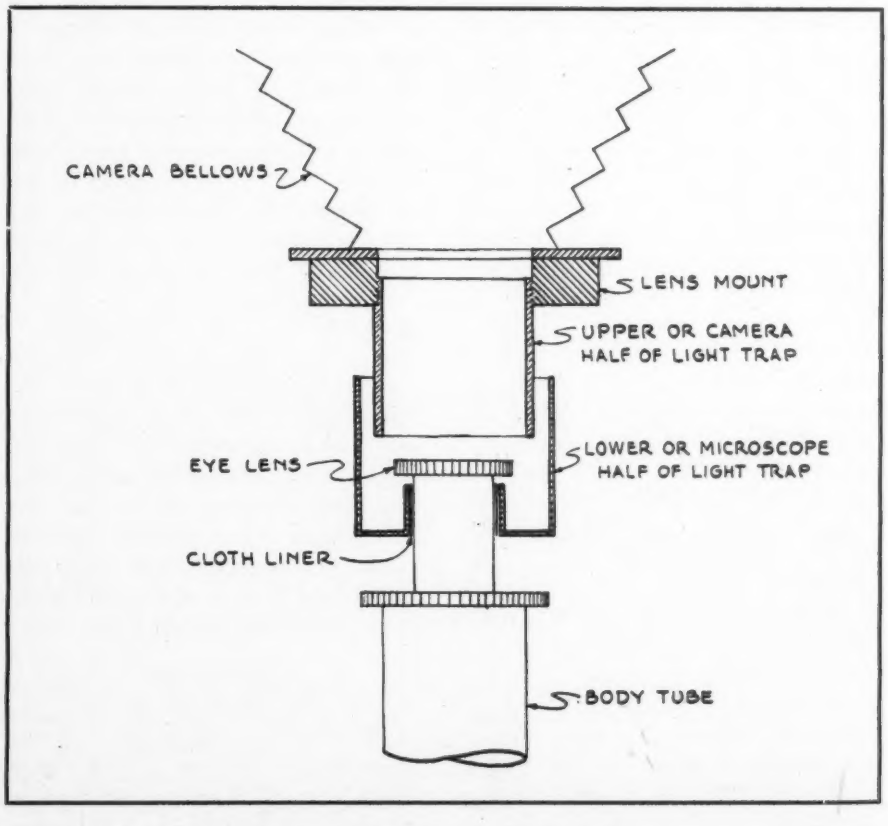


Fig. 4—Sectional view of light trap.

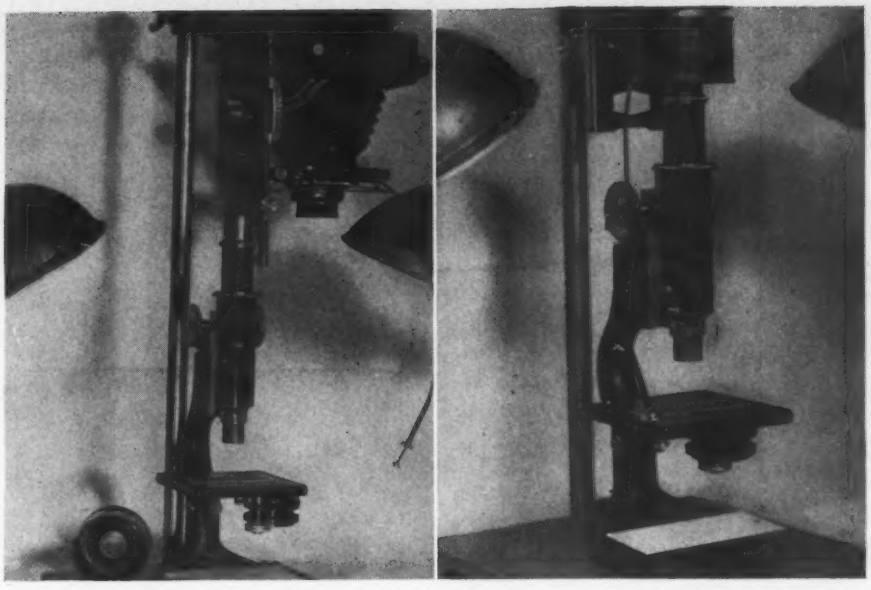


Fig. 5 (left) — Photomicrographic set-up showing camera moved to side for visual observation of specimen. Microscope half of light trap placed on base plate of stand. Fig. 6 (right)—Side view of photomicrographic set-up with camera in place and light trap in operating position ready for exposure.

or "photograph" and "micrograph." A "photograph" is a picture produced by exposing a plate or film, sensitized or coated with certain chemicals, to the action of light. A "micrograph" is an enlarged reproduction of a minute object and usually made free hand or by using a pantograph. If, however, an enlarged reproduction of a minute object is obtained photographically, the result is termed a photomicrograph.

At this point, we shall assume that everyone reading this article has at some time or another used a camera of some sort and has taken a photograph or picture and noted that light and film were required. The camera lens brought the subject to be photographed into sharp focus and with the opening of the shutter allowed the light to pass through the lens and strike the film. The film then was removed and developed to bring out the latent image produced by the action of light on the sensitized film. The film, after development and fixing, then becomes a negative. The negative is, in its simplest form, a picture in which right and left and light and shade are the reverse of those in the original subject photographed. The negative then is used to produce a positive by passing light through it. The light passes through the light portions of the negative striking a sensitized surface, the amount of light allowed to pass being dependent upon the density of the negative. The surface so exposed is then developed and fixed chemically to produce the positive which is commonly known as a picture or photograph.

A knowledge of photography is a great help in photomicrography and, needless to say, helpful if the photographer wishes to do his own developing, printing and enlarging. However, it is not absolutely necessary that the photographer have knowledge of those operations as the exposed film can be taken to a photo finisher or the "corner drugstore" and positive prints made from the film and returned to him in a manner similar to our "week-end picnic" pictures. However, the subject is so fascinating that most readers will wish to do their own work, thereby adding to the enjoyment obtained in photomicrography. For those who have little or no knowledge of the photographic art, a list of excellent books on the subject, which the author has found most instructive and helpful, will be found at the end of this article. Perhaps the shop "camera-bug" (every shop has one) can be called in by the novice photomicrographer with mutual aid, interest and benefit to all concerned.

Photomicrographic Technique

Perhaps the simplest means (although not the best) of acquainting the novice with the technique of photomicrography, is to illustrate the method used by the author, which is quite satisfactory. Realizing that most people become proficient more rapidly by the knowledge derived from others, the technique offered here has given, to date, most satisfactory results.

The setup for lights, camera and microscope is shown in Fig. 3, with the distances as indicated. The microscope rests firmly on the machined gray iron plate with the stage of the microscope parallel to the base. The iron base itself rests upon a sheet of sponge rubber to absorb undesirable vibrations. The microscope slide with the sand sample is placed on the stage, the lights turned on and a preliminary visual observation made for the most desirable field. The bottom half of the light trap (shown in Fig. 4) then is placed on the draw tube by first removing the eyepiece and then replacing same after the light trap has been placed on the draw tube (Figs. 5 and 6). The camera with the upper half of the light trap is now swung into place directly above the microscope eyepiece and locked into place by a wingnut. The camera bellows is lowered to a point where the upper and lower halves of the light trap fit well into each other but do not touch. The camera shutter then is opened and, with the ground glass in place, is ready for final focusing.

Final focusing is accomplished by focusing the microscope so that a sharp image is formed on the ground glass. A black cloth over the head of the observer and hanging well over the sides of the camera back will assist appreciably in obtaining sharp focus at this point. A hand magnifier or reading glass will also assist the observer at this point. When sharp focus has been obtained, the camera shutter is closed and the ground glass replaced with the film plate holder or film pack adapter. The exposure is now made. As a start, the photographer might try 15 sec. To find the correct exposure for certain types of sand, it is well to make the "strip exposure" test in which sections of a single film or plate are exposed for varying lengths of time by withdrawing the film or plate holder protective sheath a portion at a time. The correct exposure by this method can

easily be found. Relative to what film to use in photomicrography, a film of medium speed, such as Verichrome, Panatomic X, Process Ortho, etc., is very satisfactory. Figures 7 and 8 show the results obtained using this technique and also the appearance of various sands under the microscope.

The exposed film or plate is now developed and fixed in the usual way. Any film developer, such as Eastman's 76 for developing, followed by a clear water rinse or short stop bath, and fixed in standard sodium thiosulfate (hypo) can be used. The processed films are dried and labeled and contact prints or enlargements made as required.

Color Photography. After the novice has obtained a degree of proficiency in taking "black and white" photographs, he will, no doubt, wish to try his hand at color photography. The technique for this type of work is identical to that for "black and white" with the exception that the 100-watt lamps are replaced with No. 1 photoflood lamps for illumination and exposures of 30-35 sec. are made. Color-compensating filters may be required, due to the light absorption of certain wave lengths by the optical system of the microscope.

Light Wave Absorption

The author has found Eastman's CC-14 CC-15 filters helpful in overcoming light wave absorption by the microscope optical system. These filters are dyed gelatin filters approximately 2 x 2 in. and can be obtained mounted in optical glass or unmounted. The author uses unmounted filters which are cut from the squares into ½ x ½-in. pieces and placed directly over and on the eyepiece lens of the microscope. To prevent "finger-marking" the filters, a pair of tweezers is used for placing and removing the ½-in. squares.

Kodachrome film can be obtained in several roll film and professional cut film sizes. As Kodachrome in the larger sizes is comparatively costly, the author uses a Recomar Kodachrome adapter, which accommodates bantam size Kodachrome film.

This arrangement is neat and economical, as the individual exposures cost no more than a package of cigarettes. The exposed film is mailed to the Eastman Company and processed (the cost of the film includes this processing) and returned to the user mounted in individual 2 x 2-in. mounts ready for slide projection or for a viewer. The transparencies also can be used for making positive prints in several sizes, when taken to the Eastman Company to be processed by them.

Photomicrographers, who are interested in color photography, should find a world of information in "The Data Book on Color Photography with Kodachrome," published by the Eastman Kodak Co., Rochester, N. Y. In passing, it may be said that sand pictures in color tend to overcome one of the short-comings of "black and white" pictures in that not only are the sand grains seen in the same colors as the eye sees them, but a definite "third dimensional effect" is imparted to the picture. However, the "third dimension" unfortunately can be obtained only by a binocular type or stereoscopic type of microscope and camera when taking "black and whites."

Much can be written on the subject of photomicrography in regard to both technique and equipment. Such a discussion would lead only to lengthy dissertations on the merits and disadvantages of particular pieces of equipment and methods.

Conclusion

The author's studies of foundry sands base impressed upon him the simplicity and ease with which both visual and photographic studies can be made. He has resisted arguments concerning equipment and procedure and has produced entirely satisfactory results with a very modest initial investment.

It is sincerely hoped that many foundries that do not now possess a microscope or camera will feel a desire to explore the possibilities of using these tools in their everyday foundry practice, thereby adding immeasurably to the existing knowledge of one of the most widely used, yet perhaps least understood, basic materials in metal casting—sand.

The author wishes to thank the following persons and organizations for the cooperation and aid extended in the development of his present photomicrographic technique and in the preparation of this paper:

Miss C. Dupuy, C. H. Krause (U.S.N.), and R. E. Wick, Sand Research Laboratory, Hydro-Blast Corp., Chicago, and W. E. Smith, Eastman Kodak Co., Rochester, N. Y.

Bibliography

1. Conrad Beck, *The Microscope*, London (1921-22).
2. R. M. Allen, *The Microscope in Elementary Cast Iron Metallurgy*, American Foundrymen's Association (1939).
3. *Photomicrography*, Eastman Kodak Co., Rochester, N. Y. (1935).
4. R. M. Allen, *Photomicrography*, D. Van Nortrand Co., New York (1941).
5. Neblette, Brehm, Priest, *Elementary Photography*, MacMillan Co., New York (1942).
6. C. E. K. Mees, *The Fundamentals of Photography*, Eastman Kodak Co., Rochester, N. Y.
7. *How to Make Good Pictures*, Eastman Kodak Co., Rochester, N. Y.
8. *The Photography of Colored Objects*, Eastman Kodak Co., Rochester, N. Y.
9. Albert Johannsen, *Manual of Petrographic Methods*, McGraw-Hill Co., New York (1918).
10. Edmund J. Spitta, *Microscopy*, John Murray, London (1920).
11. H. L. Hind and W. B. Randles, *Handbook of Photomicrography*, E. P. Dutton Co., New York (1927).

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Flintermann Elected Steel Founders' Head

ELECTION OF E. D. Flintermann, Michigan Steel Casting Co., Detroit, as president of the Steel Founders' Society of America, succeeding A. M. Andorn, Penn Steel Castings Co., Chester, Pa., has been announced by the society. Mr. Flintermann will also serve as chairman of the board of directors.

Newlin T. Booth, Deemer Steel Casting Co., New Castle, Del., has been elected vice-president; and C. P. Champlin, Strong Steel Foundry Co., Buffalo, N. Y., will serve as the third member of the executive committee. Col. Merrill G. Baker has been reappointed executive vice-president; Raymond L. Collier will continue as executive secretary and Charles W. Briggs as technical and research director.

ENGINEER OF HUMAN RELATIONS

In the eyes of the average worker, the supervisor is the company. Management policies of human relations, which must be carried out by the supervisor, are only as sound as the understanding and practice of basic supervision principles.

Steven G. Garry
Foundry Division,
Caterpillar Tractor Co.
Peoria, Illinois

THOSE OF US actively engaged today have seen the era when industry turned the corner from mass production into the age of human relations. Always wide-awake to progress, industry has concentrated on a program of indoctrinating its supervisors with the basic principles underlying sound supervision. Basically, this training is, in a broad sense, a thorough course in psychology or personality development.

Every supervisor recognizes that in the final analysis his men make or break him. Naturally it is recognized that the supervisor represents management to the men, but to the average employee the supervisor is the company. Thus proper or improper supervision can make or break the company.

In industry the training programs take many courses. Some plants advocate the conference method, in which questions and answers serve as the means of providing instructions. Many other means are used, however, to provide new material—lectures, laboratory or experimental sessions, motion pictures and slides. Perhaps a combination of all these means provides the most complete treatment for all classes of supervision.

However, above all, it is particularly stressed and impressed upon the supervisor that he, or she, should learn to develop a genuine interest in people. It cannot be stressed too strongly that by acquiring the habit of success in dealing with employees, the supervisor strengthens his interest in them and with it his power to work with them.

Because of our modern industrialization, it is brought home to us emphatically that man must live with himself and with others. To live means to function, and behavior is the material of psychology. The unit of study is the individual. Psychology is one of the most useful of all of our sciences. Today industry recognizes that successful supervisors must be versatile. They must be skillful and intelligent and—they must have personality.

In one subsurvey studies were made of 3,607 men and women who had lost their jobs. It turned out that 77 per cent had been fired for tactlessness, unfairness, irritability, bad manners, etc. Therefore, specifically, well-liked supervisors must be cooperative, loyal, polite, tactful, friendly, patient, alert, daring, confident and cheerful. These qualities can be attained only by a planned foreman training program.

Not a Short Cut

First, let us stress most strongly that foreman training is not a short cut to success in business, or in life. Do not believe, as some people do, that to train supervisors is to find an open sesame to success. It will not make a mentally strong and powerful individual out of a weakling; but it can be of great assistance in bringing out the latent possibilities of people and in enabling them to adjust themselves to each other.

Industry up to the present generation frequently assumed that the minor supervisors and workers were passive instruments. In other words, the management looked upon the factory as upon a machine. No effort was made, or encouraged, to give employees an opportunity for self-expression. No effort was made to enlist and utilize their personal desires and aspirations. The personalities of the supervisor and workman were completely neglected.

Any show of undesirable individuality (and almost all individuality was considered undesirable) was respressed by discipline. The individual supervisor, or workman, did not count. Men assumed that even such complex organizations as the factory, or the mind, could be best controlled and brought to attainment by mere force.

Enlisting Support

But today, both industry and psychology are turning attention to the component units. Industrialists and psychologists are beginning to realize that the price of control by force is high—they realize the dangers of repressing and the advantages of enlisting the support of the units which compose the industrial and the mental organization.

Inasmuch as a far-thinking person can readily see how industry cannot help but benefit from the policy of training its supervision, let us approach the effect that such training can have on the supervisor personally. The human body may be likened to a plant, the personality being the flower, or bloom. Many plants survive the span of their exist-

This paper was secured as part of the 1945 "Year-'Round Foundry Congress" and is sponsored by the Foreman Training Committee of A.F.A.

ence without justifying their energy with its full meaning—that of producing a flower.

Cultivation and a degree of care are necessary to obtain the replete accomplishment. The supervisor, when trained to take a genuine interest in people, cannot help but develop poise and personality. Personal charm arises mainly from a sincere and deep interest in other people and a genuine liking for them.

He learns self-control. He builds up, by practice, the habit of censoring anger at its inception, that is, to develop strong standards of poise and self-control in all dealings. He learns by careful watching to recognize the symptoms of incipient ill temper.

He can learn to recognize that when he feels hot about the eyes, or tingling with indignation, there is trouble ahead unless prompt remedial action is taken. He can learn at the first sign of such a condition to "unhook" from the grip of the situation, to look at the matter as he judges he will a month hence, and to try to understand the point of view of the other side. He can learn to strive, by one means or another, to regain his calm.

By such measures he usually can check anger at the source. If in any case he fails to do so, he can at least get away from the situation—postpone decision, take a recess, make arrangements to go into the matter tomorrow—anything to free himself from the present tenseness and give himself time to cool off. This is a hard thing to do. It demands great self-control, for to do so he must keep in mind that he is "unfit for business."

By repeated effort, even a person with a "hair-trigger" temper can build up a sensitive censoring habit which will warn him of danger at the earliest signs of approaching anger before the excitement has taken a strong hold.

It has been said that "you cannot change human nature" in the sense that the deeper desires of man are for all practical purposes unchangeable, but we certainly can change the habits which give that "human nature" expression. By proper means and training, the supervisor can greatly develop in intellectual interest, ability, and even in character.

We can look to industrial leadership to transform through habit the unfavorable forms of expression of the common human desires into forms conducive to industrial efficiency, well-being, and peace.

Certainly, more than we ordinarily care to think, we are made skillful or inefficient, pleasant or disagreeable, noble or base, by our habits. In all of these phases of ability, or character, the habits we have acquired by learning are of tremendous importance.

Sound leadership, like other phases of supervision, does not come easily to some men, but only after long study and painstaking practice. Thus, it is and should be the purpose of foreman conferences to strengthen and develop the super-

The conference method of instructing supervisors.

Written discussions of this paper are solicited for publication in future issues of "American Foundryman" and/or bound volume of "Transactions." Discussions should be sent to Secretary, American Foundrymen's Association, 222 West Adams St., Chicago 6.

visor's leadership and, incidentally, his personality, by changing and altering his habits.

A properly organized training program should enable the supervisor to: (1) recognize the nature and extent of individual differences; (2) recognize his influence on the actions of his men; (3) learn to observe the increasing effectiveness resulting from taking advantage of individual differences in getting work done; (4) understand the nature and method of the functioning of group attitudes and morale; and (5) understand the influence of the group attitude and morale upon individual members of the group.

The supervisor of today must be an engineer in human relations. He must manage, direct, control, guide, lead and inspire those with whom he works. Industry today is teaching its supervision "how to think." Industry today is training its supervision not only in the fundamentals of supervision, but also how these principles must and can be made a part of the supervisor's personality.

Training Methods

Industry no longer has a place for the old-fashioned hit-or-miss methods of supervision. Men trained in the old methods must be retrained and brought up to date. Just as industry keeps its machinery up to date, so must supervision be kept up to date.

Primarily, the conference method of instructing supervisors in human engineering is one of indoctrination, making them management conscious, training them in the methods of formulating sound judgment, teaching them the fundamentals and principles inherent in good supervision, guiding them in the application of these principles to their own problems and following up to see that they practice what they are taught.

They are being taught new "habits" and how to apply them with good results. The most successful conclusion to any conference course is when the principles taught to the supervisor are made a part of that supervisor's own personality. One supervisor may apply them differently from another. The principles followed must be the same, but the methods of using them will vary from supervisor to supervisor.

These principles must become an integral part of the supervisor's personality so that they are the basis of his every action. Management must follow up such programs, constantly hammering home the sound principles underlying supervision until they become second nature, or part of his personality, to every supervisor. Indoctrination of supervisors with the principles of sound supervision cannot be overemphasized.

If we are to progress as successfully in the human relations era as we have in the mass production era, it will be necessary for industry to concentrate on a program of indoctrinating its supervisors with the basic principles underlying sound supervision, to see that its supervisors make these principles a part of themselves, and to follow up its supervisors to see that they practice supervision as management in its policies wants its human relations handled.

MALAY FOUNDRY

Jap-Held 4 Years, Again Member

In April 1941 the Association entered on its rolls the name of Feeo Sailai, Manager of the Kwong Thoong Fatt Foundry, whose address was given as Lahat Road (Falim), Malaya. Something of the Orient was in the application for membership, for the company's letterhead was printed in both Chinese and (fortunately) English.

History, of course, records the date of December 7, 1941, and presently mail addressed to the new member in Malaya was returned marked "Undeliverable - Enemy Occupied Territory," A silence of four years followed while the Japs drove ahead in conquest but finally were shaken loose from all they had overrun.

Early in January this year another letter reached the National Office of A.F.A. from far-off Malaya. Once again the Kwong Thoong Fatt Foundry, back in business after years of Japanese suppression, sought the benefits of membership. This letter, signed once more by our good friend Feeo Sailai, is reprinted below:

"Thanks to the war efforts of the American people, we the Chinese in Malaya, after four years of untold sufferings are delivered from the Jap domination and oppression. The undoubtful sincerity of the U.S.A. in helping our mother country both at war and in peace was also shown in past events. This gratitude shall never be forgotten.

"I now request you kindly to continue my membership with your progressive Association and also kindly waive my membership dues for 1942-1945.

"I am really grateful for your services rendered and the invaluable good learning from your publications during my first year of membership in 1941.

"I am looking forward for your unbountiful assistance in the future."

The Fatt Foundry's membership has now been restored, its dues for 1942-45 being waived, just as the Association waived "for duration" the dues of those members who served in our armed forces.

Metal Research Begun At Battelle Institute

A program of research on the patented malleable iron known as Z-Metal has begun at Battelle Memorial Institute, Columbus, Ohio.

Sponsored by the newly organized Z-Metals Research Institute, Inc., the program will include both fundamental and practical research, covering such subjects as melting, alloying, casting, and heat treatment.

Z-Metals Research Institute, Inc., is an organization for cooperative research comprising the licensor and its licensees. Its officers are Duncan P. Forbes, president of Gunite Foundries Corp., Rockford, Ill., president; Glynne Morris, vice-president, general manager, and secretary; and Lester A. Crone, a director of the Acme Steel & Malleable Iron Works, Buffalo, N. Y., treasurer.

PATTERNS . .

in the JOBBING FOUNDRY

A well-made pattern, designed for practical foundry procedure, enables the foundryman to produce a better casting at lower cost. Jobbing foundries, handling a variety of patterns, find that close cooperation with the patternmaker will solve many production problems, preserving the castings' advantages over competitive processes.

W. C. Manwell
President and
General Manager
M. B. M. Foundry Co.
Cleveland, Ohio

DESIGNERS OF EQUIPMENT work on theory, modified by practical experience. If this procedure were followed in pattern planning for foundries, better and more practical patterns would result. Unfortunately, the men who build patterns seldom have the opportunity to use them. The have little opportunity of learning to avoid in pattern design that which is learned from foundry experience.

The author has accumulated the experience of "old timers" who have used many thousands of patterns in many jobbing foundries and wishes to summarize their experiences and observations.

The company with which the author was associated normally had a changing pattern-flow of over 1000 patterns per month. Among these patterns may be found many types and variations, as the castings made weigh from a few pounds to 20 tons or more. Castings are made in green sand, dry sand, and loam, so the author's experiences are based on a wide variety of pattern requirements for jobbing work. To the experience in his present company can be added that obtained in many other foundries over a period of more than 40 years.

Some general statements can be made before beginning a detailed analysis of the practical problems in pattern design. In the first place, when there is consistent trouble with a casting, it usually is due to improper pattern design. This is particularly true when the castings have poor appearance or inaccuracies.

Improper pattern design also is responsible for certain other casting defects. Therefore, it may be said that an impractical pattern gives poor and costly castings. Conversely, a well-made pattern, designed for practical foundry procedure, usually gives a *better* casting at *lower* cost. It is the purpose of this discussion to point out some of the practical problems in foundry operation, related to patterns, which have a serious effect on both quality and cost. The considerations will be covered in detail and then summarized.

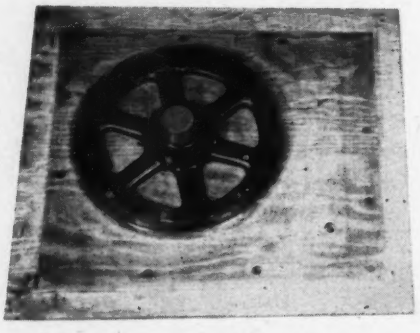


Fig. 1—Photograph (below) shows that, if a solid pattern is used, a match must be made to give a parting or the molder must cut a parting. If the pattern is split (above), it can be molded off a flat molding board or mounted permanently with permanent gating.

With a few exceptions, there is no justification for ever making a solid pattern because it is always better to work off a flat or straight mold parting. This is true from the standpoints of molding economy and appearance. To explain the foundry advantage of split patterns, let us analyze the way in which they can be used.

Reduce Required Molding Skill. If a molder has a split pattern, he does not need a match (Fig. 1) or a false cope from which to work. Nor is he required to bed-in the pattern. He simply lays the drag part of the pattern on a flat board, puts on the drag part of his flask, rams it, rolls it over and proceeds with the cope. He has no partings to make. Time is saved. Less skill is required. This simple principle of working off a flat parting should be followed even to the extent of using a core to keep the joint of the mold on a straight line.

Reduce Mold Patching. If a solid pattern is used, it has to be coped-off, which may mean patching. With the pattern split, this can be avoided.

Reduce Molding Cost. If a solid pattern is used, the rapping pin and draw screws must be used right on the face of the pattern. This soon roughs the pattern or puts holes in it. It then becomes necessary to patch all molds after a few have been made, thus making it almost impossible for a molder to produce neat castings. As patching slows up molding, costs increase (Fig. 2).

Facilitate Delivery. Split patterns

Fig. 2—A solid pattern after short foundry use. Note how face of pattern has been marred by use of a rapping bar.

make good production possible with less skill on the part of the molder. Therefore, they expedite deliveries and save defects to the customer. In every foundry, only certain molders have the patience and skill to take the necessary care with a mold when solid patterns are used. If the foundry is busy, this means that production of molds made from solid patterns must wait until one of the more skilled molders is available. This is not satisfactory, either to the foundryman or the buyer.

Patterns Mounted for Small Orders. Split patterns can always be mounted on a pattern plate, if the quantity of castings required justifies it. As jobbing foundries more and more are adopting production foundry methods, this is of utmost importance. This adaptation cannot be made with a solid pattern. As an illustration, in using split patterns, this foundry regularly mounts them on pattern plates for quantity requirements of ten castings, and sometimes less. This enables production to be improved by the molding machine method.

The pattern draw is improved by the use of a vibrator, and planned permanent gates can be used. This eliminates the necessity of the molder cutting the gates. All of these points benefit both the foundry and the buyer. The foundry's molding and cleaning costs are reduced and the buyer gets better castings at a lower price. Figure 1 (left) shows a split gear blank pattern which has been mounted on a board.

Pattern Loose Pieces

There are occasions when it is necessary to use loose pieces on large patterns. However, in the main, this should be avoided when a core can be used between the point involved and the mold parting. Some reasons for this are:

a. A loose piece may shift in ramming, particularly if it becomes very loose on the pattern.

b. When the loose piece is removed, the mold may be damaged in a way that makes patching difficult, so that a good casting cannot be made.

c. The use of loose pieces slows up production and requires more skilled men. Therefore, deliveries are slowed up, costs increase, and neatness and accuracy of the castings are jeopardized.

d. Loose pieces should be plainly numbered, if they *must* be used. This applies to the core box as well as to pattern loose pieces. Faint marks, so often used to designate the location for loose pieces, soon disappear after a pattern or core box is used a while. It is then very difficult to tell where the parts belong. If there are many loose pieces with different combinations, there should be a log or index stamped on the pattern and core boxes showing the numbers of the loose pieces and the combinations required to make the proper casting. This is necessary so that the foundryman really knows when he has the right pieces in the proper location. It is a simple precaution to reduce the scrap castings and avoids delicate situations with customers resulting from errors which are costly, yet virtually unavoidable, if proper patterns are not provided.

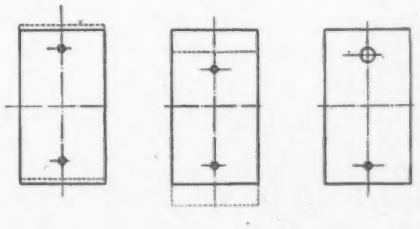


Fig. 3—Diagrammatic illustration of how carelessly placed dowel pins may cause molding errors and how the errors may be avoided. Left—Dowels placed almost symmetrically. Dotted line shows a part of the pattern shift that might not be noticed if the cope is reversed. Center—Dowels are definitely off center. If the cope pattern is reversed, the molder will notice it at once. Right—Two different sized dowels are used and it is impossible to reverse the cope part of the pattern.

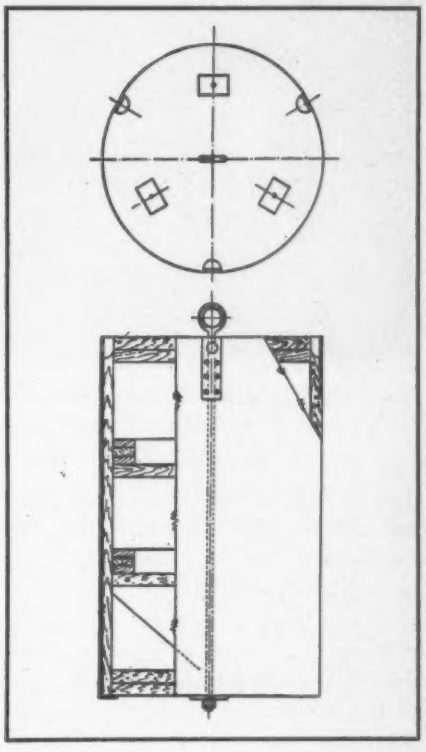


Fig. 4—Sketch showing (a) draw straps running down outside of drum pattern and hooking under the pattern, and (b) draw bolts running down inside of the drum pattern to plates on bottom. In either case, note strong bracing inside the pattern so that it will not distort or expand when the pull is applied to withdraw pattern from the mold.

Dowel Pins. The author wonders if patternmakers have ever thought of the scrap caused by putting the same sized dowel pins on each end of a pattern and then keeping the

This paper was secured as part of the 1945 "Year-'Round Foundry Congress" and is sponsored by the Patternmaking Division of A.F.A.

Fig. 5—Pattern for a heavy marine cylinder. It is made in sections, numbers 1, 2, 3 and 4 being outside sections. Center section not shown.

pins so near centerlines that, after the molder rolls the drag over, he cannot tell how to put on the cope part of the pattern.

Dowel pins should be off center sufficiently to make it obvious to the molder that he has put the cope part of the pattern on wrong, or the patternmaker should use two different sized dowel pins so that it is impossible to put the cope half of the pattern on wrong (Fig. 3).

Draw Straps. On large patterns, the matter of draw straps or draw bolts is important. The author prefers draw straps. If the pattern is large, such steel straps should extend down to the bottom of the pattern and hook under it, so that the pull will be from the bottom. The straps should be placed on the pattern core print, if that is practical. If they must be on the pattern, it is advisable to set the strap into the pattern to avoid excessive mold patching.

The pattern should be well braced and built around the point where the straps will pull. If this is not done, the pattern will be so badly twisted after one or two draws that it will have to be repaired before additional castings can be made. As stated, the author prefers draw straps on a pattern because he believes that their use is simpler and less likely to damage the pattern for future use. If well constructed, a pattern with draw bolts is a good pattern, provided its construction is planned so that the pull is directly from the bottom of the pattern (Fig. 4).

Sectional Large Patterns

It seems to the author that patternmakers seldom think about building a large pattern in sections around a center that can be drawn out separately from the outside sections. One wonders sometimes if those learning the trade have ever heard about the method. Let us describe a case in point. The job is a large marine cylinder which will weigh about 11 tons. It is to be cast on end.

If the pattern is made in one piece and provided with good draw straps, the pull is enormous when the pattern is removed from the sand; first, because of the friction of the sand against the pattern, and second, because of the vacuum created as the pattern starts to leave the bottom of the mold. This strain is hard on the best of patterns and, after being used a relatively few times, the pattern is ready for rebuilding, if accuracy is to be maintained—in fact, if any castings are to be made at all.

Suppose a center is made around which four sections are built (Fig. 5). Then, when the mold is rammed, the center part of the pattern is drawn easily and each section easily removed separately afterward, leaving the mold in good condition for economical finishing. With such construction, the pattern is not damaged. The foundry with which the author is associated has had a cylinder pattern of the type described in use for over three years without requiring any major repairs.

This clearly shows the advantages of such construction. This method of pattern construction often could be followed with profit on large patterns where more than one or two castings are required. It would preserve the pattern investment for the purchaser and give him better castings. Such patterns are easier to handle, and easier to store.

Pattern Distortion

Many times, the patternmakers seem to forget that lumber will swell when it remains in the mold for any length of time. This is due to dampness of the sand and is an important point to remember. Take for instance a long, flat pattern, such as a surface or bolster plate. The boards in the pattern should not be put on the face tight to each other. There should be a 1/16 to 1/8-in. spacing between them on the large surfaces to allow for swelling. This retains greater accuracy in the patterns and makes better castings.

Side Boards to Bottom. One of the nightmares of a foundryman is to get large patterns with the side boards not extending to the bottom of the pattern. The patternmaker will build up the sides like a box and then put on the bottom. He usually will finish the bottom edge to a good match before it leaves the shop (although many times he does not do a good job of that either).

Invariably, after such a pattern is in use, the bottom boards swell, and then they will extend a little over the side wall boards of the pattern. When that takes place, the pattern is securely anchored in the mold. All that can be done under such conditions is to pull and pull until the mold is destroyed in getting the pattern out, or until the pattern is broken drawing it out of the mold. One rule which should be followed in large pattern construction is "Always run the side boards of a large wood pattern to the bottom."

Pattern Draft. The author sometimes wonders how patternmakers expect a foundryman to hook out

pockets where there are deep ribs, when little or no taper or draft is allowed. Without sufficient draft, the pockets will be torn when drawing the pattern. This is especially true in lifting off the cope. The result is that much time is spent by the molder in patching and nailing. This requires excessive finishing, which results in increased costs and lower quality castings.

Core prints are another problem facing the foundrymen. Core prints are used to support and to help hold the core in place. It is difficult to make a rule, and a visit to the foundry by the patternmaker will help considerably. One gets better castings if he does not have to reduce the size of the core by rubbing.

Shrink Rule

The patternmaker makes the mistake of constructing the pattern and core to the same shrink rule for large patterns. For small bench work, made in green sand, the same rule can be used. But for larger castings, made in dry sand, it is a headache to the foundry. To help this condition *use the shrink rule on the pattern and the common rule or 1/16-in. shrink rule on the core box.* Then the core will readily go into and fit the core print without rubbing.

Taper on Core Prints. Core prints, in the bottom of a mold, should have a slight taper. Where the core is not tapered to suit the core print, the smallest part of the core print should be made to fit the straight part of the core, the taper providing the clearance.

Cope and Drag Prints. It is advisable to avoid putting core prints on the cope side of a pattern unless they are used to locate a core or to hold a core in place. Cores, that are secured in the drag and cut through to the cope, do not need cope core prints because the cores are already located in the mold and the touch of the cope holds them in place. Therefore, by omitting the core prints in the cope simpler molding is provided. Such practice also helps to make cleaner castings by eliminating the danger of crushing when closing the mold for the last time.

There are some cases where core prints should be omitted in the drag, if possible. For instance, where the body of the core is larger than the core print, it is impossible for the molder to see the core print when he sets the core. He works blindly.

Length of Core Prints. The length of core prints depends upon their position and their purpose in the mold. If they are to locate a core, they should be about 1-in. deep, but if they are to support a core and hold it in place, they may run from 1½ to 5 or 6-in. long, depending upon the weight and size of the core.

Short core prints often cause scrap castings because they will not support the weight of a heavy core running crosswise in the mold and do not provide sufficient bearing to hold a core correctly in position. Likewise, if core prints are too short and lie horizontally, venting to remove gas created in pouring is almost impossible.

Clearance on Core Prints. Patternmakers could provide simpler molding by allowing clearance in the drag half of the core print as well as in the cope half. This saves the molder from shaving back the core print or rubbing the core. In other words, a sand core has rods in it and, in drying, may have small heat cracks, making the core a little longer. The longer the core, the more rubbing a molder must do to get the core into the mold. The rubbing could be avoided by allowing the same clearance on the drag half core prints that is customary for the cope half core print.

Witness on Core Prints. Witnesses on core prints should always be included (1) when it is possible to reverse the core when placing it into the mold, (2) when the core can be used in either of two places and is correct in only one, or (3) rotation of the core will make an improper casting.

This thought seems simple and unnecessary. It would be out of place only for the fact that patternmakers so often neglect to put witnesses on core prints under these conditions, and in such cases the foundryman runs into trouble. Allied to this same thought is the matter of loose core prints on a pattern held in place by dowel pins. If the dowel pins are the same for several loose prints so that they can be reversed, trouble results. Ways should be used to prevent such errors, either by witnesses or other methods.

Fillets. To have a molder cut fillets on a mold where the patternmaker indicates that they should be, by mark with a crayon or color paint, makes expensive molding, because the mold has to be cleaned out after the fillets are cut and that takes time. It also might be added that, when fillets are so cut, they are not always a good job.

Fig. 6—Frame for a punch press. The broken casting was used as a pattern. The frame was split. The center was lifted out with an arbor. Lagging was put on to allow for shrinkage and finish where required. The mold was ready 3 days after the broken casting arrived at the foundry.

Fig. 7—Large bull gear. Only one was required. To make the casting, all that was required was (1) a sweep to form the bottom of the mold, (2) a pattern section for ramming the outside, and (3) core boxes to set up one section from arm to arm.

Therefore, it should be concluded that for better casting appearance, the fillets should be mounted permanently on the pattern.

This subject might be referred to as patterns for one casting or, at the best, two or three. This problem needs consideration because, if the pattern for such a part is made to standard practice, the cost is so great that the finished part is very expensive. Because of this high cost, the buyer may consider other ways to solve his problem at a lower final cost and may begin to figure the use of weldments instead of castings. Such a procedure by the buyer loses business both for the pattern shop and for the foundry. Often there are ways to reduce this over-all cost by better pattern and casting planning.

If the patternmaker would seek the foundryman's assistance on such occasions, it would be profitable for both the foundry and pattern shop.

Using Castings for Patterns. Old castings often can be used as a body for a pattern by lagging certain parts of the casting for machine finish or shrinkage, by building on some core prints and by making suitable core boxes. This makes a low pattern cost, a slightly higher casting price, but a reasonable over-all cost (Fig. 6).

Core Assembly. Take a large gear blank as an example of a casting, only one of which is to be made. The expense for a full pattern is too great to make an over-all cost practical. On the other hand, one can make a segment pattern to form the outside diameter of the mold and work it around a spindle after sweeping a flat bottom. Then he can make a segment core box for half cores, working off a proper parting line. And finally, one can use a flat cope rammed on a plate; or cover cores, weighed off to secure the main cores forming the arms and hub.

This planning will give inexpensive pattern rigging for one large gear blank at a reasonable over-all cost that will be practical under the conditions. The segment patterns and core boxes are not too expensive. The casting cost itself may be a little over normal, but the over-all cost is consistent for such a job.

Figure 7 shows how sweeps and core assemblies can be used as an economical procedure to meet competition under these circumstances. It is an old practice that is being forgotten by the younger patternmakers.

Pull-up Patterns. Let us consider pull-up patterns or sweeps as another short cut for these one-time or short-run jobs. The type of castings, where this practice applies on small orders, is for castings like a pipe, cylinder liner, or crane drum. Suppose the job is to be 6, 8, or 10 ft. long. It can be cast on end. Here it is possible to use a section of pattern only 24 or 30 in. long.

The molder can keep drawing it up to a gage stick as layers of the mold are rammed, until the correct height of ramming has been obtained. Again, such a pattern is relatively inexpensive and, while the casting price may be a trifle more than normal, still the over-all cost of the job to the customer is reasonable. The pattern storage problem also is simplified. In fact, the pattern may even be thrown away.

This pull-up procedure applies mostly to jobs which are big enough to allow the molder to either get inside or reach inside for finishing the mold. However, sometimes a mold can be split into sections so that the molder can finish the mold by reaching, when the sections are separated.

Sweep Patterns. Another and cheaper way for making these larger cylindrical-type jobs should be mentioned. That is by using sweeps for loam molding. Here again, pattern costs fade away. The mold cost increases somewhat, but a nice job is obtained at a reasonable over-all price to the customer.

Half Patterns. Many jobs are symmetrical and many foundries are tooled to take advantage of this symmetry by using only half patterns. Such practice reduces pattern costs against the job. In fact, even on good production jobs, half patterns can be used if one knows that the foundry works off molding plates or molding boards using good pin centers.

The pattern can be properly and

accurately mounted around center lines to produce excellent castings. In such cases, a full pattern is a waste of money. The author believes that, as a matter of good will between customer and pattern shop, and foundry, these economies always should be employed.

Carrying this thought further, the author often has used quite large half patterns without mounting them on a plate or board. Suppose a job is to be made on its side. A half pattern is made, and then a dummy is made to fit into the core prints of the drag half of the mold and strips are run along the joint of the drag to support the half pattern when it is used for the cope. Methods like those which have been mentioned should be remembered for these one-time requirements to keep the customer casting-conscious and satisfied.

Skeleton Patterns. Let us consider skeleton patterns. They may be considered to be in two classes: (1) *plain*—for flat or bolster plates, etc., and (2) *larger*—for rather complicated castings.

The foundry has a customer who purchases many die plates for metal-working dies. To keep the costs reasonable, the patternmaker made a frame of the right thickness on which he placed bosses and cross supports where he wanted them. These were put on tightly or with dowels. He made sweep sticks to strike out the metal thickness within the frame before drawing the pattern from the drag. This was a simple, inexpensive pattern procedure. No pattern was used more than once.

The customer used so many patterns that storage was impossible. The result was that we charged a little more for castings than we would have charged with first class patterns, but the over-all job costs were much lower. We sold this customer thousands of dollars worth of castings each month. It was a practical solution to the customer's problem.

This instance shows again how the patternmaker, foundry, and customer can cooperate to the advantage of all from a good business standpoint. It is one way for foundries to meet competition on this kind of work.

The other field for skeleton patterns is for large pipes, cylinders, valve bodies, etc. In this case, the pattern shop also must work with the foundry. Sometimes the core can even be rammed in the mold. In either case, after ramming, the metal thickness is cut out by sweeps.

As an illustration of how this works, it might be mentioned that the author's foundry made a series of pumps and valve body parts for a firm in California some years ago. The castings weighed from 4 to 8 tons each. Figure 8 (see front cover) shows the large pump housings made from skeleton patterns which were destroyed after the job was finished. The skeleton was so made that the core was made in the mold and lifted out with an arbor for finishing and drying.

The pattern shop cooperated in making skeleton patterns, which brought the pattern price sufficiently low to make an over-all job price practical. As a result, the customer placed the order in Cleveland instead of shipping the castings from the West Coast where better patterns existed. When the job was finished the patterns were scrapped.

This represents an ultimate in design of patterns for short-run requirements. It is a practice, however, that must be given more attention and one that patternmakers should be thinking about for future competition.

Shellac and Color

The author believes that almost every foundryman feels that if a wood pattern is made and good shellac, or some substitute for shellac to which sand will not stick, is not available, then *leave the shellac off the pattern altogether.*

It is certainly disheartening to the molder and disastrous to costs, as well as destructive to quality, to draw a pattern and then find a large amount of the molding sand stuck right to the pattern because of poor shellac. Poor shellac can make a mess of a mold. Therefore, do not try to save a few pennies on shellac.

As for color, it is so long ago since the American Foundrymen's Association started advocating red for finish surfaces, yellow for core prints, and black for the unfinished parts of the casting, that those who participated in drawing up the A.F.A. Standard Pattern Colors are beginning to feel like old men. Yet, the practice of using these three colors properly is followed very little. The writer is sure that foundrymen would recommend that patternmakers follow this procedure. It would be helpful.

Shrinkage is no real problem on small patterns, but horse sense must be used about shrinkage on large patterns. The author will point out a few of the larger hazards.

Iron or steel will shrink a certain amount per foot of length when cast in a straight bar. But, that is not definite assurance that complicated castings, having many cores, or that castings of various shapes will shrink that same amount per foot in all directions. They do not. That is the reason why good, practical judgment must be used in laying out a pattern from a shrinkage standpoint.

Shrinkage

Take a long bed plate, a long pipe, or a cylinder with flanges on the ends. Who knows absolutely that it will shrink, say one-tenth in. per ft. on the length between flanges? One cannot be sure. The cores probably will hold the casting and not allow it to shrink fully. If the casting is not allowed to shrink fully, how about the end flange thickness after machining? They will be thin and perhaps the customer will not take the job.

To obviate this, the flanges should be backed-up with extra metal. Make the flanges sufficiently heavy so that they will not be too thin if the casting does not shrink as planned. The outside ends will certainly have plenty of finish, but look out for the inside dimensions. Allow extra finish or back-up the flanges, or do both.

If pattern dimensions are checked against dimensions of castings made from those patterns, it will be found that the shrinkage problem is an uncertain one and that it is necessary to safeguard pattern dimensions by allowing for probable variations.

As an example, let us consider cylindrical castings with cores. Such castings do not shrink "to rule" on the diameter. Most of the shrinkage is lengthwise. Often it is necessary to make larger cylinders with shrinkage allowance slightly over common rule measurements on diameters. If such allowance is not made, when the job is finished there is too much finish on the outside diameter and none or practically none on the inside diameter.

To illustrate this point, some time ago the foundry took on a liner job

in which the liners were made with finish bands only on the outside diameter, to save machining cost. The customer was objecting because he had to machine the whole length of the outside diameter to use the casting. There was practically no finish on the inside. We measured the pattern and the casting on diameter. They were alike. No shrinkage had taken place on diameter; it was all lengthwise.

Thereafter, on this type of job, the customer used common rule on the diameter and shrink rule on the length when making this type of pattern. This is only one illustration. Many such instances could be quoted on piston rings, wire blocks, and other circular parts, to show that precautions must be taken for a sensible use of shrinkage allowances, as derived from experience and casting design.

Smaller items to be watched in making jobbing patterns are placing core prints properly to get core balance in a mold, and placing them so that core wires and core rods can be removed from the casting. One also might mention some generalities about plain practicability of patterns for molding, such as the avoidance of three-part molding, etc.

Figures 9 and 10 illustrate patterns in which moldability has not been considered. On the left in Fig. 9 is a pattern as supplied by a customer and which required three-part molding. The molding cost was high and good castings were difficult to make.

At the right in Fig. 9 is the new pattern for the same casting. This pattern required only cope and drag and a core was used to form the center portion. With the new pattern, molding was easy, cost reduced and more accurate and better appearing castings produced.

Figure 10 shows a pattern that is improperly designed. It is a bench job. The flange, as can be noted, was made as loose sections which are held in position with pins. Molding was extremely slow and only the most skilled molders could be used. The castings made from this pattern were not of high quality.

This pattern should have been made as a split pattern, which could have been molded on the side using a flat parting. Had the pattern been so made, costs would have been reduced materially and better castings produced.

Many problems, incident to the use of miscellaneous patterns in a jobbing foundry, have been mentioned, and a short summary of the main points might be helpful.

1. Split patterns are the most desirable type for many reasons, among them lower costs and better castings. Seldom is a solid pattern preferable, when straight parting is impossible.

2. The problem of loose pieces on patterns and in core boxes needs constant attention for good operation.

3. Care in the use and placement of dowel pins will prevent many errors and reduce casting losses.

4. Large patterns, properly reinforced and provided with proper draw straps, thoughtfully placed and securely fastened, will contribute to better castings at a lower cost and to longer pattern life.

5. When designing large patterns, consider sectional pattern principle.

6. Applying the lumber to patterns properly will help jobbing foundries and give customers better castings and pattern satisfaction.

7. Make core prints properly so that the cores may be correctly located, locked and secured. This is an essential point in better casting production.

8. Use good fillets to improve casting appearance and make sounder castings.

9. When designing patterns for one-time usage or for several castings, consider use of assemblies of cores, an old casting for a pattern, and skeleton patterns.

10. The proper engineering finish of a pattern with good shellac and standard colors is advocated.

11. Both patternmakers and foundrymen should become more familiar with shrinkage changes to give maximum satisfaction to the customer.

The author has shown that there is a close tie between patternmakers and the foundry, and that there should be close cooperation between them because they have a common interest. The foundry and patternmakers will prosper together and the customer ultimately will decide their fate. Today, sand castings have competition as never before from stampings, die castings, permanent mold castings, plastics, weldments, etc. We must, therefore, understand each other's problems and work together for the common benefit, which finally resolves itself into a cooperative effort to please the customer. The author hopes that this paper has been helpful in laying a better foundation for such benefits.

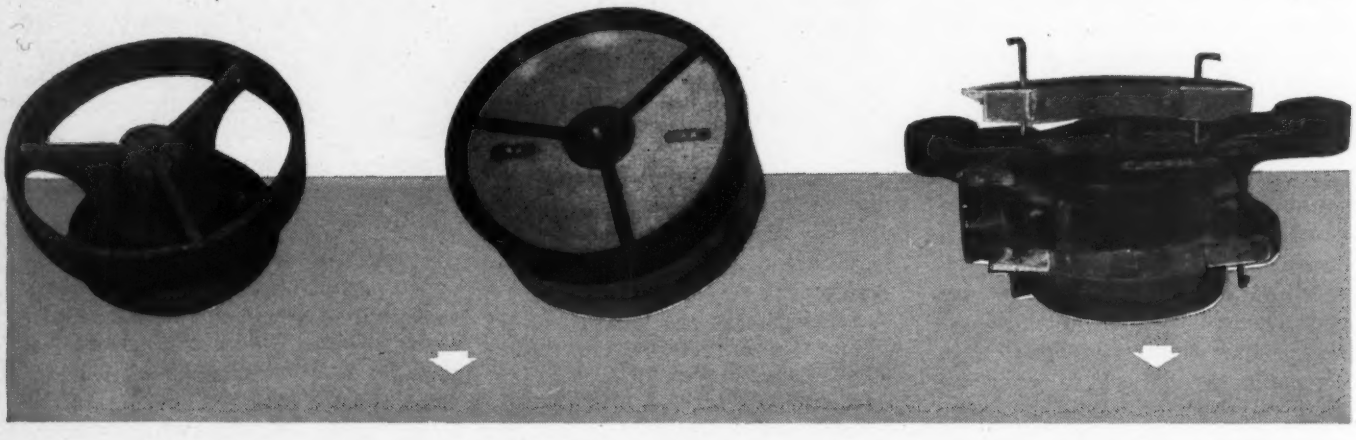


Fig. 9—(Above) Pattern required 3-part molding. (Center) New Pattern requiring only cope and drag.

Fig. 10—Improperly designed pattern. Flange is made in loose sections held in position with pins.

BOARD OF DIRECTORS
Considers Mid-Year Status of A.F.A.

PROGRESS REPORTS of Association activities were approved by the A.F.A. Directors at the midyear meeting of the Board of Directors held at the Palmer House, Chicago, January 16, one of the shortest and most businesslike board meetings ever held. The Board gave particular attention to the 50th Anniversary Foundry Congress and Exhibit, reports on membership and finances and to the improved content and scope of the AMERICAN FOUNDRYMAN.

Director R. J. Teetor, Cadillac Malleable Iron Co., Cadillac, Mich., as Chairman of the Finance Committee showed that the Association's financial condition was in excellent shape as of December 31, 1945, especially with reference to the budget governing activities of the current fiscal year, this budget representing the largest in the Association's history.

Membership Still Rising

For the membership committee, Vice-President S. V. Wood, Minneapolis Electric Steel Castings Co., Minneapolis, reported most favorably on membership reaction to the increased dues which went into effect July 1, 1945. He announced, as of the date of the Board meeting, a gain rather than a net loss in members, and that this favorable report had been made possible only through the loyal and splendid support of the various chapter membership committees. He pointed out that the 33 chapters of A.F.A. represented a group within the castings industry capable of solving, through cooperative action, any problem that may face the industry in the years ahead.

Other reports by Committees on the Board were presented by Chairman Wood for the Chapter Contact Committee; Chairman R. T. Rycroft, Jewell Alloy & Malleable Co., Buffalo, N. Y., for the Management Committee; Chairman Joseph Sully, Sully Brass Foundry, Toronto, Ont., for the Youth Encouragement Committee; and Chairman W. B. Wallis, Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa., for the AMERICAN FOUNDRYMAN Policy Committee.

The report of the AMERICAN FOUNDRYMAN Policy Committee showed that the magazine, in the first eight months of its present extended form, has more than accomplished the objectives set for it, both in the way of anticipated advertising acceptance and from the standpoint of increased reader interest. Future plans for the magazine were discussed, and means of increasing its value to the membership and to the industry as a whole were outlined and approved by the Directors.

Past President L. C. Wilson, Reading, Pa., as Chairman of the 1946 Nominating Committee, reported on nominations for President, Vice-President and five new Directors. This report is covered completely by an article (p. 18) in this issue.

The A.F.A. Secretary presented a complete report on the progress of the 50th Anniversary Foundry Congress and Show, to be held in the Cleveland Auditorium, May 6-10. He called attention to the excellent schedule of sessions tentatively prepared (to be found on p. 38 in this issue of AMERICAN FOUNDRYMAN), and reported that applications for exhibit space already assured the largest foundry show in A.F.A. history.

Changed Conditions

By way of comparison with conditions one year ago which necessitated cancellation of the 1945 convention in Detroit, the Secretary called attention to the announced removal of rail restrictions in March, gradual relaxation in crowded hotel conditions, and the tremendous interest already shown by foundrymen planning to attend the May meeting. It was stated, too, that the considerable interest shown by foundrymen in foreign countries assures a colorful and representative contingent from abroad.

The Board of Directors approved holding the Annual Banquet of A.F.A. on the night of Friday, May 10, although as yet no announcement has been made as to the hotel that will be privileged to serve this event. Reservation requests will undoubtedly be mailed earlier this year than previously, and announcement will be made in the March issue of AMERICAN FOUNDRYMAN as to the feature speaker for the Annual Banquet.

The Secretary reported that a Mexican Chapter and a Central Illinois Chapter had been installed during the first half of the current fiscal year, the 32d and 33d Chapters of the Association. President F. J. Walls, International Nickel Co., Detroit, who presided at both the Executive Committee and Board meetings, reported excellent reactions from the Chapter Chairman Conference held last July, and the Chapter visits of National Officers and Directors since then. He urged the Directors to continue these visits whenever possible so that closer cooperation with local groups and the National organization can be continuously maintained.

Educational Work

The report of the Technical Development Program, presented by Vice-President Wood as Chairman of the Advisory Committee, called particular attention to the national educational program of A.F.A. The complete outline of this program was published in the January issue of AMERICAN FOUNDRYMAN, and more detailed information on various phases of the program is being printed in succeeding issues. Through cooperation of local chapters of A.F.A. and groups of foundrymen, plus work of the National Headquarters, this program is being carried forward progressively on behalf of the entire industry.

Approval was given by the Board for financial support to the operating foundry exhibit maintained since 1935 at the Chicago Museum of Science and Industry. This exhibit, one of the most outstanding examples of a foundry exhibit in the country, attracts over 40,000 visitors each year and is one of the most popular displays of this world renowned museum.

Dues Setup Altered

The Board voted, on recommendation of the Executive Committee, to revise the method of handling new memberships so that henceforth new memberships will be considered on a year-to-year basis, instead of on a fiscal year basis as in the past. Thus, the prorating of dues to the end of the fiscal year will be discontinued hereafter, and instead each new member will be billed for dues

(Concluded on page 45)

TECHNICAL PROGRAM

TAKES SHAPE

THE PROGRAM of meetings, to be held during the 50th Anniversary A.F.A. Foundry Congress May 6-10 in Cleveland, is now rapidly developing and many worthwhile papers on a wide variety of foundry subjects have been received. With the Program and Paper Committees of the various divisions swinging into full gear, all activities are now pointing toward a full scale foundrymen's week of exceptional value to the industry.

On the adjoining page, the first tentative schedule of sessions will be found, subject to minor changes as additional program activities are more fully developed. Meanwhile with this tentative schedule, which has been mailed to all members of the Association, those who are planning to attend the Congress will be able to plan their hotel and rail accommodations accordingly.

Official hotel application blanks have been mailed to the entire membership and to all exhibitors of record. Each new member and additional exhibitor will also receive the necessary applications and information for their attendance, and it is urged that hotel reservation requests be made immediately.

While it is not as yet possible to make rail reservations this far in advance, it has already been announced that government restrictions on transportation will be removed completely by March 15. This in itself is expected to relieve considerable burden from the hotels.

Assignment of rooms for the A.F.A. Golden Jubilee meeting will commence about February 15 and room assignments will be made as rapidly as possible thereafter. Each individual making request for accommodations will be notified by the A.F.A. Housing Bureau and in addition the hotel to which he may be assigned will confirm the reservation made. Additional applications should be sent direct to the Housing Bureau, 1604 Terminal Tower, Cleveland 13, Ohio.

Already the applications for space thus far received assure one of the largest exhibits ever held in conjunction with an A.F.A. convention. Previous predictions are already being fulfilled on the number of new and improved products that will be on display at this "all out show," including a considerable number of new exhibitors.

The Lecture Course Session to be held this year will be given in five parts, one on each day of the meeting. While the subject has not yet been announced, it will be of interest to the majority of the foundrymen attending.

The Annual Lecture Course has been a popular feature of past conventions. This year the subject chosen by the Annual Lecture Course Committee is "Foundry Control Methods." A full discussion of this subject is not anticipated and plans are being made to carry the series at the 1947 convention. It is then hoped that the lectures will be made available to all foundrymen in book form.

Another popular group of sessions will be conducted by the Sand Shop Operation Course and will be presented on May 6, 7, 8 and 9.

As will be seen by the tentative schedule of meetings, each of the A.F.A. divisions will have its full share of activities throughout the week. In addition, there will be a luncheon for Engineering School Alumni groups, and a Chapter Officers and Directors dinner on May 7, a Foundry Instructors dinner and sessions on Training Problems May 8.

The Annual Dinner of the Association will be staged Friday, May 10, and the Alumni Dinner for past Officers and Directors is scheduled for Thursday evening. The Annual Business Meeting of the Association is scheduled for the morning of Thursday, May 9.

Lists of technical and practical papers are now being compiled and will be published in part in the March issue of AMERICAN FOUNDRYMAN. The full program will appear in the Golden Jubilee number of the magazine, the April issue.

The tentative schedule of sessions, 50th Anniversary Foundry Congress to be held in Cleveland, May 6-10, is shown on the adjoining page.

The six divisions of the Association, namely, Gray Iron, Malleable, Steel, Brass and Bronze, Aluminum and Magnesium, and Patternmaking, are planning to bring to the members who attend their sessions as much information as possible on every day production problems.

Acting as official host to the Congress will be the Northeastern Ohio chapter, under the chairmanship of A. C. Denison, Fulton Foundry & Machine Co., Cleveland. Chairmen of the various Congress activities have been selected and will be announced in a future issue.

Tentative Schedule of Sessions

50th Anniversary Foundry Congress

Cleveland — May 6-10

Monday, May 6

	Exhibits Open
10:00 am	Opening Session
12 noon	Aluminum and Magnesium Round Table
4:00 pm	Lecture Course Session—(1)
8:00 pm	(a) Sand Shop Course—(1)
	(b) Joint Meeting Plant Equipment — Safety and Hygiene
	(c) Aluminum and Magnesium Session

Tuesday, May 7

10:00 am	(a) Malleable Foundry Practice
	(b) Aluminum and Magnesium Session
	(c) Inspection of Castings
12 noon	Luncheon—Engineering School Alumni Groups
2:00 to 10:00 pm	Northeastern Ohio Day
2:00 pm	(a) Inspection of Castings
	(b) Refractories
	(c) Malleable Foundry Practice
4:00 pm	(a) Aluminum and Magnesium Session
	(b) Lecture Course Session—(2)
7:00 pm	Chapter Officers and Directors Dinner
8:00 pm	(a) Refractories
	(b) Sand Shop Course—(2)

Wednesday, May 8

10:00 am	(a) Malleable Foundry Practice
	(b) Brass and Bronze
	(c) Sand Research
	(d) Gray Iron
12 noon	(a) Brass and Bronze Round Table Luncheon
	(b) Malleable Round Table Luncheon
2:00 pm	(a) Sand Research

Wednesday, May 8—(Continued)

4:00 pm	(a) Sand Shop Course—(3)
	(b) Lecture Course Session—(3)
7:00 pm	Foundry Instructors' Dinner
8:00 pm	(a) Foreman Training
	(b) Engineering Student Training

Thursday, May 9

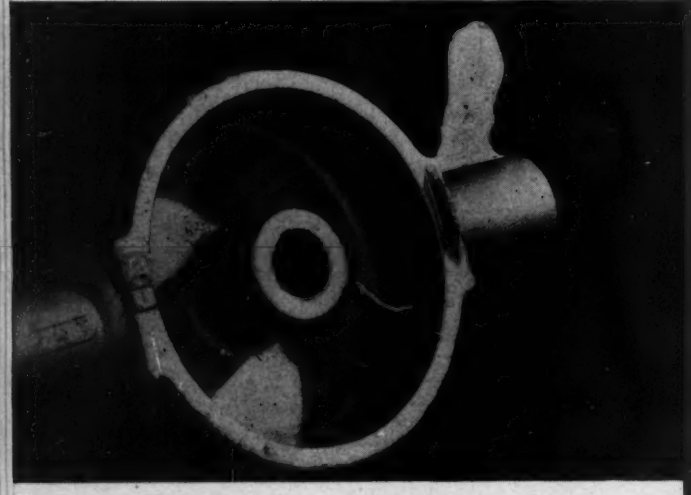
9:30 am	Annual Business Meeting
12 noon	Steel Round Table Luncheon
2:00 pm	(a) Brass and Bronze
	(b) Patternmaking
	(c) Gray Iron
	(d) Steel
4:00 pm	(a) Foundry Costs
	(b) Apprentice Training
	(c) Lecture Course Session—(4)
	(d) Gray Iron
7:00 pm	Alumni Dinner
8:00 pm	(a) Sand Shop Course—(4)
	(b) Job Evaluation and Time Study
	(c) Apprentice Training

Friday, May 10

9:30 am	Sand Shop Course—(5)
10:00 am	(a) Gray Iron
	(b) Steel
	(c) Job Evaluation and Time Study
2:00 pm	(a) Steel
	(b) Gray Iron
	(c) Brass and Bronze
4:00 pm	Lecture Course Session—(5)
5:00 pm	Exhibits Officially Close
7:00 pm	ANNUAL DINNER

Drag of squeezer plate.

Cope, showing conventional heading and gate.



Drag view of same set-up.

Cope with heads and gate.

NECKED-DOWN RISER

Sam Belus
Burnside Steel Foundry Co.
Chicago

FROM A PAPER presented before the Wisconsin Chapter of A.F.A., Sept. 14, 1945, the author has selected the photographs which will, he believes, show rather clearly how a certain troublesome job was simplified in the jobbing foundry.

Most foundrymen are familiar with the type of head known as the "necked-down riser," as many articles have been published as to ways and means for its application.

Many foundrymen are old hands in arriving at proper core thicknesses and their openings. For those who have had less time for experimenting along that line, the author would like to pass on a simple method which has proved very successful in the foundry with which he is connected.

This foundry is considered a jobbing shop, and encounters various types and designs of castings. Because a jobbing shop has but little time for experimenting, it is necessary to stay on the safe side in determining thickness and size of core openings. The 1x1½ method is used for the core opening. The thickness of the core is governed by the shape and practicability in making. The size of the head is determined by either the 2½ method or by weight, whichever the design of the casting may call for.

For example, let us say that we have a valve body with an 8 in. diameter flange, 1 in. thick, with a 3-in. opening. We would either multiply the 1 in. thick flange by 2½, which would give us a 2½ in. diameter head, or we could estimate the weight of flange and make the head in proportion, let us say, to an approximate 50 per cent yield.

While this is not a concrete method, it is a

Cross sections showing area that must be cleaned.

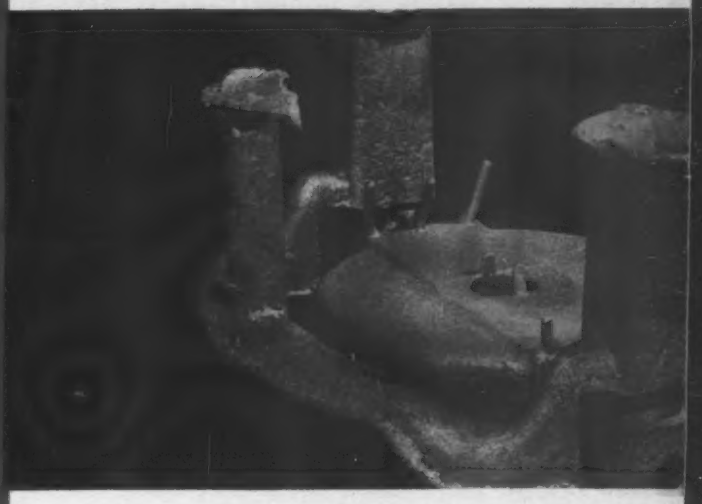
Views of sectioned casting.

Casting after flogging.

rather fair barometer in trying to maintain a yield on castings, and it eliminates partial guesswork. Following through for the core opening by the 1x1½ method, which would mean that the core opening would be 1 in. wide and 1½ in long. The thickness of the core would be ⅜-in., as this is a simple core to make.

In this foundry an oilless core also is used to eliminate gases. This is very important. External surface chills also can be used on certain types of jobs to good advantage.

With due respect to everything that has been said about necked-down risers, the author believes that, with all the data that have been printed, any foundryman could easily adapt this practice to suit a particular foundry set-up.



Casting before flogging.

Flogging Core Mixture

Silica sand, lb.	300
Core oil, qt.	1.5
Iron oxide, qt.	2.0
Cereal bender, qt.	2.5
Moisture, per cent	2.5

Casting Cleaning Costs

Old Way		*New Way*	
Burning	.0826	Flogging	.0200
Std. Grinding	.0969	Std. Grinding	.0645
Light Chipping	.0173	Light Chipping	.0236
Total	.1968	Total	.1081

Drag view of casting.

Present set-up, pin-push machines, set-chills.

Cope with flogging core print, heads, and set g

FOUNDRIES AID

ENGINEERING SCHOOLS

ANY PROGRAM for cooperation between the foundry industry and engineering schools and colleges must be based on an understanding of the needs of the industry and an appreciation of what educational institutions have to offer casting producers.

An important phase of the A.F.A. National Educational Program, outlined in the January AMERICAN FOUNDRYMAN, concerns the development of better relations between the casting industry and engineering schools. How these relations can be improved is described at more length in this article. Other aspects of the national educational program will be considered in succeeding issues.

In an effort to obtain information from the engineering schools and colleges on the type of cooperation they might prefer from the foundry industry, A.F.A. approached deans of engineering schools throughout the country. Some valuable replies were received and many of these are briefed elsewhere in this article.

In general, the engineering schools indicated an almost unanimous desire to cooperate more closely with foundry executives. The replies indicated that relatively few foundrymen, in comparison with the executives of other industries, maintain close contact with major educational institutions in their home states.

This preliminary survey, made late in 1944, was further strengthened by a questionnaire to engineering schools and colleges instituted by the Public Relations Committee of the Foundry Equipment Manufacturers Association, under the chairmanship of B. L. Simpson, National Engineering Co., Chicago. The F.E.M.A. questionnaire sought information on methods of operation in effect at individual schools and possibilities for developing a closer working arrangement.

The results of this survey are presented in an accompanying article on "Foundry Industry and Educational Institutions" by A. J. Tuscany, Executive Secretary of F.E.M.A. This article is well worth the study of progressive foundry executives, especially that section dealing with present foundry facilities and future needs of institutions. An interesting and valuable comparison can be made between the stated needs of engineering schools as to equipment for foundry training courses, in comparison with the general cooperative suggestions received in answer to the A.F.A. survey of 1944.

How Industry Can Help

Engineering colleges and universities train the metallurgists, chemists, casting designers, and other engineers who form a small but significant part of the personnel of the foundry industry. Clearly, the function of a university, or engineering college, is two-fold: to train all engineering students in the basic principles and application of cast metals, and in addition, to train a limited number to enter the foundry industry. The foundry industry must acquaint higher educational institutions with its needs.

The A.F.A. Committee on Cooperation with Engineering Schools, includes prominent foundrymen as well as educators in the field of metallurgy, engineering and foundry practice. Aiding both schools and chapters in a variety of ways, the committee annually sponsors several sessions at the annual A.F.A. convention, including an Engineering Instructors' Dinner at which educational problems are discussed from both the foundry and educational standpoints. Chapters can aid in the work by encouraging local foundry instructors to attend the convention dinner and the sessions.

Better Instructors Needed

The best advertisement for the foundry industry in an engineering school is a capable foundry instructor who has the respect of his students and who is able to select and influence certain students to enter the foundry industry. The foundry instructor should be a graduate in metallurgy, or in chemical engineering or mechanical engineering with a liberal dose of metallurgy, and should have a good record of interest in the casting industry.

The average educational institutions today are short of instructional manpower and where it is known that an instructor in foundry practice is needed, the Educational committee of the chapter in that area should assume some of the responsibility for locating a desirable man. It may even be necessary for industry to provide the man by loaning a plant metallurgist with interest and teaching ability, perhaps on a part-time basis.

College foundry instructors are changing the older system of laboratory periods and now devote about half the class time to lectures. This requires teaching aids of all sorts, most valuable of which are motion pictures, slides, models, exhibits. Mo-

tion pictures and sound strips which have been made especially for the foundry industry are reported in a bulletin issued by the A.F.A. National Office. Films which may be purchased have in some instances been paid for by A.F.A. chapters and put in college film libraries.

Exhibits, which in themselves are an important phase of the program for publicizing castings, may be given entirely or in part to engineering schools after the exhibit has served its purpose in libraries, museums, show windows of public utilities and the like.

Even the most enthusiastic foundry instructor welcomes a breathing spell now and then, and so do the students. The Wisconsin chapter has worked out a plan with the University of Wisconsin, Madison, and Marquette University, Milwaukee, Wis., whereby 15 one-hour lectures are delivered to the graduating class in foundry work. Lecturing on all phases of the foundry industry according to a prescribed plan, chapter members take the instructor's place, giving the students first hand information about the commercial production of castings, and affording them an opportunity to see what sort of men are engaged in the technical fields of foundry practice.

Foundry Offers Opportunities

The plan has been effective in assuring the engineering graduate that the foundry offers a place in which to apply engineering techniques, and in which manpower competition is not excessive. The latter is true because there are so few technically trained men in the industry while the number of known unsolved problems is inordinately large.

Some chapters have established excellent relations with departments and instructors other than those in which foundry practice is taught, by supplying speakers to student engineering societies. In addition, students and instructors of other departments should be invited to chapter meetings whenever the speaker's topic relates to a branch of science, engineering or manufacturing other than foundry practice.

Students in electrical engineering, for instance, rarely receive instruction in foundry practice and would therefore be very interested in the production and use of castings for electrical equipment. That result is a better understanding of modern foundry practice on the part of the students and their instructors.

Particular attention should be paid to instructors in machine design, strength of materials and similar courses. Frequently the instruction in foundry practice given these men has been wholly inadequate from the modern point of view. A classic example of the lack of familiarity with cast metals is found in the instructor in automotive engines who reprimanded a student for insisting that piston rings were made of cast iron.

A.F.A. Chapters Assist

Almost every A.F.A. chapter has assisted some engineering school in securing equipment and supplies at cost or as a donation. This is no small aid because most educational institutions operate on limited budgets, and school foundries generally receive meager funds because of the inferior position they occupy in the minds of school administrators.

Surplus government property is available under certain conditions to educational institutions merely for the cost of transportation. Chapters can aid by locating and reporting surplus equipment to nearby engineering schools, or to the A.F.A. national office.

At one of the largest universities in the country a department head recently stated that the foundry was receiving special consideration because the foundrymen were the only representatives of any industry which had offered assistance in planning the layout and equipment for a proposed new building. The foundry industry, through the efforts of the Educational committee of the A.F.A. chapter in that area, should derive benefits in the form of greater appreciation of castings, and in the form of an increased number of engineering students who select the foundry as a career.

It is a good plan to ask department heads, deans and even college presidents to speak at appropriate foundry gatherings on some subject related to the foundry industry. In acquainting himself with the foundry industry, the speaker invariably develops a genuine interest in local foundries, and in the foundry division of his own school.

Summer employment in a foundry is a good means of maintaining student interest in the casting industry. It also affords the employer a chance to study the young man under actual working conditions, thus enabling him to judge better whether the student would fit into the organization after graduation.

Foundry Instructor

The foundry instructor should not be forgotten over the summer vacation period. Most foundry instructors are hired for a period of nine to ten months and are usually available for work during the balance of the year. A job in a commercial foundry helps the instructor balance his budget, gives him the industrial contact that every university staff member needs, and forms a closer bond between the chapter and the school.

The practice of offering summer employment to foundry instructors might be developed profitably into an exchange system whereby foundry instructors are replaced every few years by a man from industry. The industrial man would have a fresh outlook on modern foundry problems, and the foundry instructor would fit readily into a number of technical foundry positions.

Essay Contests Sponsored

Several chapters sponsor annual essay contests in the engineering schools in their district. The Twin City chapter has been particularly active in this respect, the contest raising enthusiasm among students and chapter members alike. At a special chapter meeting designated "Student Night," three authors present their prize winning papers at a session patterned after a convention technical session, complete with chairman, and questions from the floor. The prize winners invariably have several offers of summer or permanent foundry jobs before they leave the meeting. Past winners who are not in the armed forces are working in foundries at the present time.

Chapters may wish to sponsor research on foundry problems, the work to be done at a nearby engineering school. Research projects should be chosen with care for several reasons. Many foundry laboratories have limited equipment and may not be able to undertake proposed work. Universities are not

interested in ordinary testing work which might be carried on better by commercial laboratories. Preferably the project would be one of a basic nature, related to a fundamental foundry problem.

Scholarships for college engineering students have been contemplated by some chapters or by individual foundries. The idea has great merit. An undergraduate scholarship should not be offered with the understanding that the student will devote all his time to the study of foundry practice. The idea is not in agreement with modern educational trends.

For several decades there was a trend toward specialization with degrees in every conceivable subject. A degree of "Foundry Engineer" has been proposed, but no college has as yet offered such a degree. Now there is a movement toward a broader technical education which is expected to produce an engineering graduate with greater ability and imagination.

After graduation, a scholarship offered to a student of proven ability would enable him to continue his education by specializing in some field of foundry practice. He also would approach foundry practice with a broad scientific background that research in the complex field of casting production requires.

A visit to the engineering library of any university or college reveals a number of books dealing with the foundry industry. For the most part these books would be interesting to a collector, and no doubt have great value to a historian, but not to a foundryman. For the most part, they are somewhat out of date. In general they represent the foundry industry as most laymen think of it, and are therefore bad advertising and detrimental to the industry.

The remedy is simple. One of the functions of a chapter educational committee is to examine engineering and technical libraries, and to inform the librarian of modern books and periodicals related to castings which should be on the shelves. Most librarians are willing to purchase books for which there is a request since one of the functions of a library, particularly in a public institution, is to keep at hand refer- and detrimental to the industry.

Regional conferences, successful in many chapter areas, give the chapter an opportunity to work with school administrators and staff members in a joint educational project. The advertising value operates in two directions, giving the industry recognition for its technical advances, and the school recognition for its meeting and teaching facilities, its laboratories and staff. Numerous chapters, such as the Wisconsin, Chicago, Central Indiana, Central New York, Metropolitan, Michiana, Philadelphia, Quad City and Western New York, have held regional foundry conferences jointly with local universities.

Engineering Deans Help

Answers to a questionnaire sent to deans of the country's foremost engineering schools and colleges are summarized below. Completed in 1944, the survey was made by A.F.A. to determine what the casting industry could do to encourage foundry instruction in engineering schools and to attract more graduate engineers to the nation's foundries. Many of the deans offered the same suggestions although there were a variety of answers. They are well worth consideration by every chapter.

Summary of A.F.A. Questionnaire to Engineering Schools

Provide special films on features of foundry industry.

Exchange personnel for one year: college graduates in industry to teach for a year, being replaced by college instructors.

Allocate experimental research to universities.

Supply engineering schools with illustrative material to assist the faculties in presenting the significance of foundry problems in connection with design.

Grant scholarships and fellowships in the field of castings so as to attract better students and incite their competition.

Supply accurate information for instructors on the fundamentals of casting and foundry practice.

Supply instructional aids for instructors—very large and high quality photos; slides and motion pictures on principles; typical castings, cores and patterns; models of molds ready for pouring.

Provide lists of research projects suitable for upperclassmen and graduates to work on.

Employ engineering students during summer vacations; also consider employment of upperclassmen on part-time basis.

Sponsor lectures by technical foundrymen of engineering interest.

Sponsor (or allocate) research at engineering schools of fundamental and scientific nature.

Set up foundry graduate schools in large foundry centers.

Sponsor addresses to graduating groups on advantages of foundry career.

Return better men to engineering colleges for advanced study, on either full or part-time basis.

Provide undergraduate scholarships for men now in foundry industry.

Sponsor a summer course for engineering instructors, on the technical level.

Publish articles and papers in pamphlet form for distribution to engineering students, covering foundry subject.

Issue a handbook of the entire industry.

Select graduates during their senior years and offer employment upon graduation with an advanced training program; perhaps offer also a full or partly subsidized post-graduate course.

Arrange technical meetings between A.F.A. chapters and student groups.

Induce technical foundrymen to address student seminars.

Arrange inspection tours of modern foundries by engineering students; also arrange for foundrymen to visit schools.

Urge foundrymen to take active interest in Society for the Promotion of Engineering Education.

Make more effort to show college men they are welcome into the industry.

Prepare foundry courses in evening college programs, on the college level.

Have members of A.F.A. call on college presidents and engineering deans, so as to indicate growth, importance and needs of foundry industry.

Have foundry representatives visit colleges and interest seniors in the foundry industry and its opportunities.

Publish technical papers at low cost for student and faculty use.

Issue monthly or quarterly bulletin to students, with articles by foundry authorities.

Encourage engineering schools to convert foundries from shops to laboratory courses, and recommend plans of equipment and courses desirable from standpoint of the industry.

Prepare films for distribution to student branches of engineering societies.

Establish cooperative courses between the universities and industry.

Sell the industry to engineering students the same as is done by other industries.

Interest high school boys through engineering college courses or by in-service training.

Interest engineering schools in offering extension courses in larger cities.

Circulate trade magazines among college libraries and faculties.

A.F.A. Nominates

(Continued from page 19)

Association who will continue on the Board are as follows:

F. J. Dost, Sterling Foundry Co., Wellington, Ohio.

S. D. Russell, Phoenix Iron Works, Oakland, Calif.

R. T. Rycroft, Jewell Alloy & Malleable Co., Inc., Buffalo, N. Y.

Joseph Sully, Sully Brass Foundry Ltd., Toronto, Ontario.

L. C. Wilson, Reading, Pa.

George K. Dreher, Ampco Metal, Inc., Milwaukee.

E. W. Horlebein, Gibson & Kirk Co., Baltimore, Md.

H. H. Judson, Goulds Pumps, Inc., Seneca Falls, N. Y.

James H. Smith, General Motors Corp., Detroit.

F. M. Wittlinger, Texas Electric Steel Casting Co., Houston, Texas.

Heat Resistant Alloys Studied by Institute

UNDER THE SPONSORSHIP, Navy Office of Research and Inventions, a program of research on the fundamental knowledge of the "why" of heat resistant alloys for gas turbine and jet propelled planes will be conducted at Battelle Memorial Institute, Columbus, Ohio. The institute's technologist, will attempt to put knowledge of high temperature materials on a scientific basis in the hope that it will lead to the ability to predict even superior compositions.

Canadians Plan Student Foundry Training Course

A JOINT COMMITTEE, under a three-year agreement between the British Columbia Industrial and Scientific Research Council and the School Board at Vancouver, B. C., Canada, will consider plans for the training of 15 to 20 students a year for the foundry industry. The expenses of an experimental foundry, which will be established at Vancouver Technical School, will be shared by the two groups.

Establishment of the experimental foundry was recommended by the metal trades section of the Canadian Manufacturers' Association to provide a source of adequately trained foundry personnel. Also recommended was a night course for advanced training.

Board of Directors

(Continued from page 37)

during the same month of each consecutive year.

In addition to President Walls and Vice-President Wood, the following National Directors attended the January 16 Board meeting:

D. P. Forbes, Gunite Foundries, Inc., Rockford, Ill.; Roy M. Jacobs, Standard Brass Works, Milwaukee; Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va.; Harry Reitinger, Emerson Engineers, New York; Ralph J. Teetor, Cadillac Malleable Iron Co., Cadillac, Mich.; W. B. Wallis, Pittsburgh Lectromelt Furnace Corp., Pittsburgh; F. J. Dost, Sterling Foundry Co., Wellington, Ohio; S. D. Russell, Phoenix Iron Works, Oakland, Calif.; R. T. Rycroft, Jewell Alloy & Malleable Co., Inc., Buffalo, N. Y.; Joseph Sully, Sully Brass Foundry Ltd., Toronto, Ontario; Lee C. Wilson, Reading, Pa.; George K. Dreher, Ampco Metal, Inc., Milwaukee; Harold H. Judson, Goulds Pumps, Inc., Seneca Falls, N. Y.; and F. M. Wittlinger, Texas Electric Steel Casting Co., Houston, Texas.

Executive Committee Meets

The Board meeting was preceded by a meeting of the Executive Committee on January 15, at which time a number of operating policies were discussed. Among the subjects considered were finances, membership work, Technical Development Program publications, research work, safety and hygiene activities, 1946 preprint policy, and National office staff procedure. The Committee approved reinstatement of the Association's former preprint policy, whereby all papers printed prior to the 1946 convention will be made available to the entire membership.

L. C. Wilson Establishes Sales Agency in Reading

LEE C. WILSON, past president of A.F.A., has established an engineering sales agency with headquarters in Reading, Pa., where he has been located for many years. He has been appointed sales agent for Ross-Meehan Foundries, Chattanooga, Tenn., in the district of Pennsylvania, Maryland and Delaware. Mr. Wilson was formerly vice-president and general manager of the Reading Steel Casting Div., American Chain & Cable Co., Inc., Reading, Pa.

Industrial Encyclopedia

The National Research Bureau, Inc., 415 No. Dearborn St., Chicago, is making available to business executives a new type of encyclopedia that aids in locating business information sources quickly. Covers every phase of industry, government, agriculture and commerce.

CUPOLA

OPERATION AND CONTROL

W. W. Levi
Metallurgist
Lynchburg Foundry Co.
Lynchburg, Va.

THE SUBJECT of cupola operation and control is, to say the least, a most controversial one and, in spite of the fact that there are almost as many cupola procedures as there are operators, results are, for the most part, quite satisfactory.

The discussion which follows is a brief description of the practices followed in the foundries with which the writer is connected, and are not necessarily intended to serve as "cure-alls" for the entire foundry industry.

One of the first requirements for successful cupola operation is an exact knowledge of the composition and behavior of the raw materials used. This involves chiefly the metallic components of the cupola charge and the metallurgical coke or cokes on hand or available. Needless to say, the limestone, dolomite, or whatever fluxing material is used, should be of the best quality.

Each carload of pig iron should be checked against the shipper's analysis. The analysis of a carload of purchased cast iron scrap would be an almost endless task and would be of very little value after it was completed. However, this should not discourage the use of large percentages of cast scrap in the cupola charge, as the composition of the various types of scrap available is known quite definitely.

However, the party responsible for the purchasing of scrap should insist that any given carload contain only one type of scrap and not a mixture of several kinds. Each carload should be rigidly inspected, both upon arrival in the iron yard and during the course of unloading to the storage piles or to the charging cars or buckets.

After a brief period of training in the recognition of various types of scrap, crane operators and charging crews can offer invaluable assistance to the cupola foreman, as they see practically every piece of iron used during the course of operation.

Weighing equipment for metal and coke charges must be checked frequently and kept in good repair. Above all, when metal composition must be held within very narrow limits, as is required in certain types of castings such as cylinder liners, and when making malleable iron by the duplex process, where the initial melting and superheating is done in the cupola furnace, the weighing equipment selected must be accurate, sensitive over the range in which it is used, and intelligently chosen for the job it is intended to do.

For example, 250 or 300 lb. of coke (or 25 lb. of 50 per cent lump ferrosilicon) ordinarily cannot be weighed accurately on a set of scales designed for heavy loads where the tare weight of the charging car and bucket may be 3,000 or 4,000 lb. This is not a hypothetical case, as just such a set of conditions exists in one plant of this company, and will be discussed in more detail later.

The cupola has proved itself a most versatile melting unit, capable of producing a wide variety of irons satisfactory for innumerable engineering applications.

While it may be considered rather elementary at this time to enter into the matter of "lighting-off" the cupola coke bed, there are one or two items which are worthy of note. In one of this company's foundries the kindling wood and practically all of the bed coke are put into the cupola at one time. About 6 hr. before "wind-time" the bed is "lit-off" and allowed to burn through very slowly. Before any metal is charged the bed is levelled off with cold coke, and charging then proceeds until the cupola is full.

In another foundry the bed coke is put into the cupola in three equal portions at 2-hr. intervals, while in a third department about one-half of the bed is "lit-off" only about 4 hr. ahead of "wind-time," and here it is necessary to use a gentle blast to thoroughly ignite the coke. All of these procedures are satisfactory and, if sufficient kindling wood is used, the first iron tapped will be amply hot.

The longer burning-in time is preferable, as this results in better preheating of the cupola lining and well, and when cupolas are operated on alternate days plenty of time is available. However, when it is necessary to use the same cupola every day there usually is less time available (after completion of the daily "patching" job) between light-off-time and wind-time.

In order to provide a large volume of fluid slag as soon after the start of the heat as possible, two extra charges of limestone are placed on the bed just before charging starts, and 4 lb. of fused soda ash per ton

of metal are used on each charge used to fill the cupola in addition to the regular charge of limestone.

The layer of slag thus formed acts as a protective covering over the molten iron in the cupola well, resulting in considerably higher melting temperatures at the start of the heat. This may be due to the fact that the slag blanket protects the molten iron from the cooling effect of the incoming blast, or heat losses through radiation from the surface of the molten metal are reduced.

The foundries with which the writer is connected produce sand-cast pressure pipe and fittings, a complete line of chilled plows, diesel engine cylinder jackets and liners, marine engine bearings, bases, frames and cylinders up to 70-in. bore with 48-in. stroke, automotive and agricultural implement castings, pressure valves for oil, water and gas, locomotive cylinders, and machine tool castings.

A variety of castings used by the chemical industry, such as caustic pots, ingot molds, jacketed kettles, lead pots, billet molds and the like are produced. In addition to these, the company manufactures super-deLavaud pipe ranging in size from 3 to 36 in. in diameter and 18 ft. long, cast centrifugally in water-cooled steel molds.

Figure 1 shows a low pressure marine engine cylinder casting having a 70-in. bore and 48-in. stroke. The average chemical analysis of the iron used for these cylinder castings will fall within the following ranges:

Component	*Per Cent*
Silicon	1.70-1.90
Sulphur	0.09 max.
Phosphorus	0.20 max.
Manganese	0.75-0.90
Total carbon	3.00-3.25

The silicon content of the iron from the cupola spout is somewhat lower than that found in the finished castings and, consequently, a "late addition" of 75 per cent grade ferro-silicon is made. This addition increases the silicon content from 0.20-0.30 per cent. A "late addition" of 0.3 per cent (3 lb. of alloy per 1000 lb. of molten iron) of zirconium silicide also is made to the molten iron. These additions cleanse the iron, reduce chilling tendency, and materially increase toughness.

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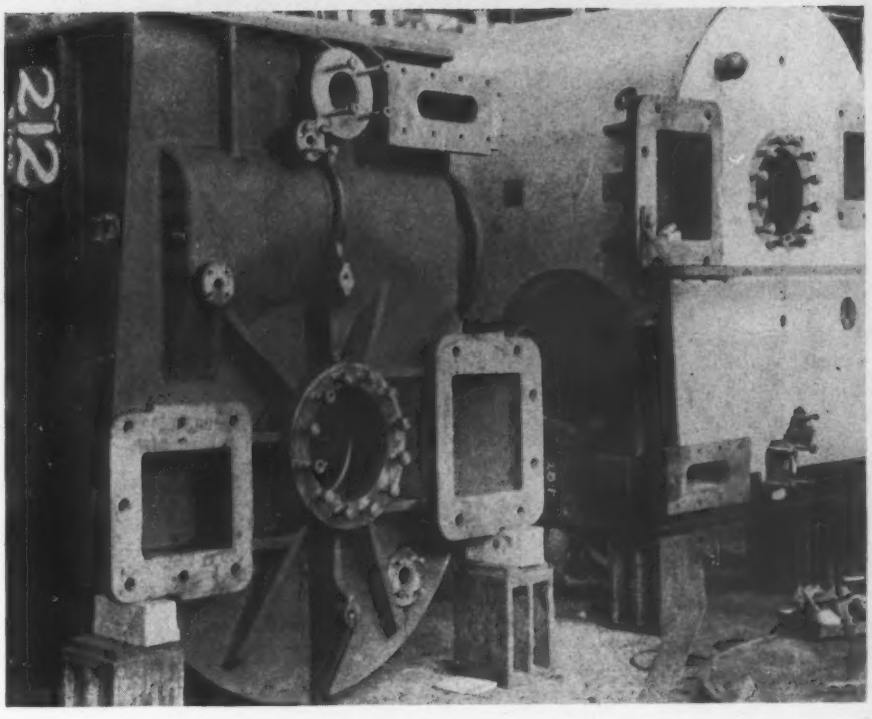


Fig. 1—Low pressure marine engine cylinder, 70-in. bore and 48-in. stroke.

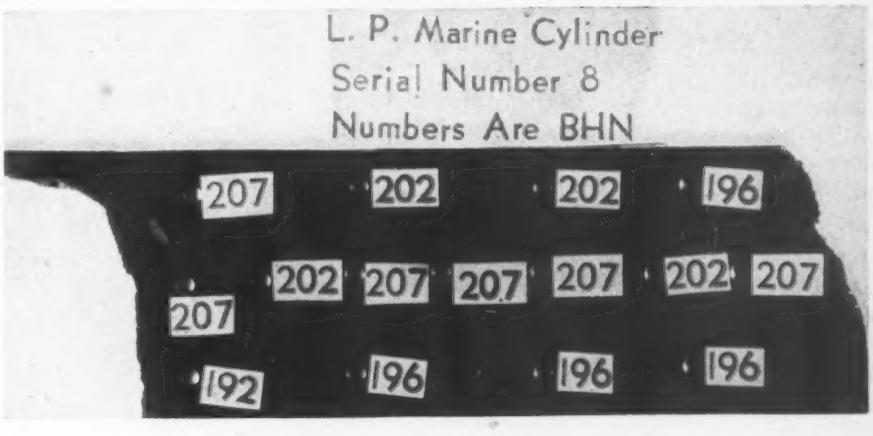


Fig. 2—Section from 2⅜-in. main wall of low pressure cylinder casting showing results of hardness tests.

The strength of tensile test specimens machined from separately cast standard arbitration bars runs from 42,000 psi. to 48,000 psi., with corresponding Brinell hardness numbers ranging from 217 to 241. On three occasions tensile test specimens have been machined from the 2⅜-in. thick main wall of cylinder castings. The results of these tests along with results obtained on corresponding specimens machined from standard arbitration bars are tabulated in Table 1.

Figure 2 shows a section from the 2⅜-in. thick main wall of a low pressure cylinder casting. Indentations are impressions made by the 10-mm. ball on the Brinell hardness testing machine, and figures indicate Brinell hardness at the various points. The uniformity in hardness is attributed to the "processing"

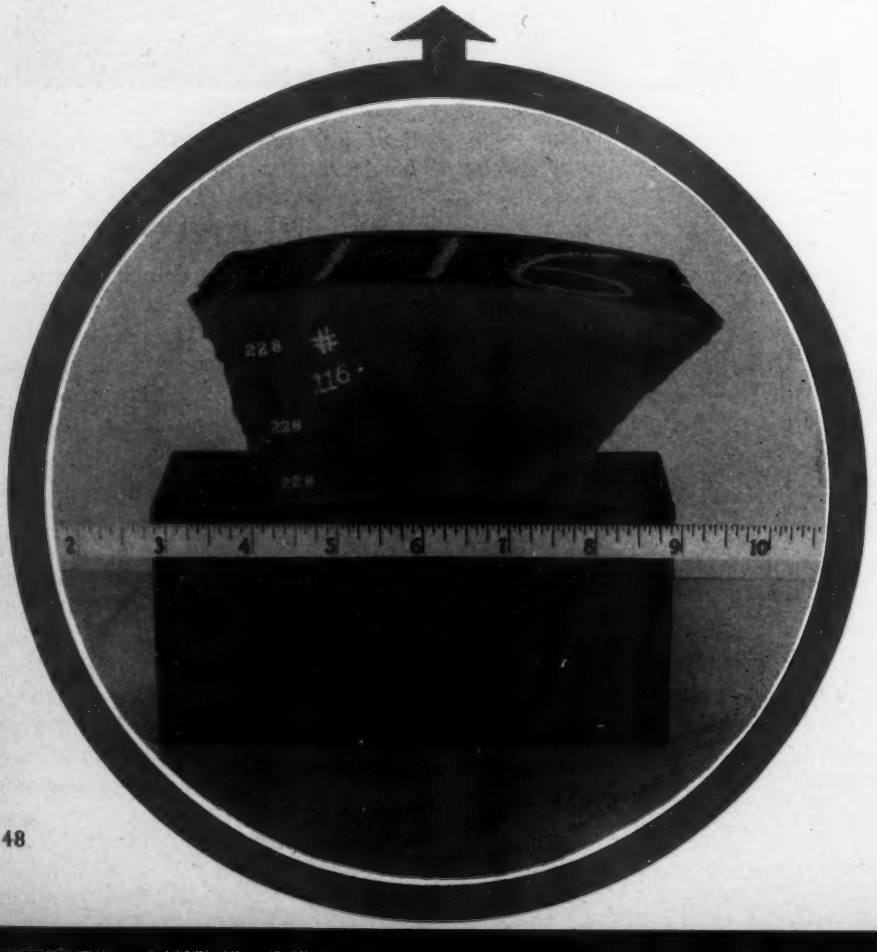
Table 1

PHYSICAL PROPERTIES

1.20 Bar Specimens		*Cylinder Wall Specimens*	
Tensile Strength, psi.	*BHN*	*Tensile Strength, psi.*	*BHN*
42,673	228	34,000	196
43,990	228	35,905	196
48,200	235	34,900	192

Fig. 3—Cylinder lining casting (21.5-in. I. D.) after removal from mold, shown in casting position. Sprue at right and cylindrical gate at bottom. Riser shown at upper left is 5-in. diameter and 18-in. length.

Fig. 4—Hardness test specimen machined from lower end of cylinder liner similar to one shown in Fig. 3. Brinell hardness of 228 was recorded at three points across the section, which is 2⅝-in. thick.



treatment to which the iron was subjected.

A cylinder liner casting (21.5 in. I.D.) just after removal from the mold is shown in Fig. 2. The liner is in casting position with sprue at right and cylindrical gate at bottom. The riser shown at upper left is 5 in. in diameter and 18 in. long. Chemical composition and physical properties of the iron used are as follows:

Component	*Per Cent*
Silicon	1.15-1.40
Sulphur	0.10 max.
Phosphorus	0.20 max.
Manganese	0.70-0.90
Total carbon	3.00-3.25
Molybdenum	0.40-0.50
Vanadium	0.12-0.18
Chromium	0.15-0.30

Tensile strength on specimens machined from Class C (2.00-in. diameter) test bars is 43,000 to 48,000 psi. The cupola mixture used for the cylinder liner casting is of the following percentage:

Malleable pig iron	30.0
Silvery pig (8 per cent Si)	7.5
Steel scrap (No. 2)	57.5
Manganese steel scrap	5.0

A hardness test specimen machined from a cylinder liner casting is shown in Fig. 4. A section of the 5-in. riser from the cylinder liner casting (Fig. 3) is shown in Fig. 5, and the machining operation is shown in Fig. 6.

Carbon Control

From the foregoing it is apparent that many "grades" of iron are necessary to produce castings of proper strength and composition to render them suitable for the applications for which they are intended. For example, the iron used in large cylinder liners (21.5-in. I.D.) will contain far too little total carbon for use in super-deLavaud pipe, and the iron used in a caustic pot would be much too high in total carbon for use in cylinder liners and so on.

While the writer has not overlooked the importance of the other elements entering into the chemistry of the iron, it is felt that the total carbon present is of extreme importance in its influence on the properties of the finished product.

The total carbon content of the iron is, of course, influenced by factors such as the percentage of steel scrap and/or pig iron in the charge, the amount and type of coke used, blast pressure, blast temperature, melting rate, tapping technique,

melting temperature, auxiliary equipment used in connection with the cupolas, and many others.

As previously stated, a definite knowledge of the chemistry of the raw materials used is very important. For example, total carbon determinations are made of all samples of pig iron in addition to the determination of the usual elements. This, along with a knowledge of the total carbon content of the other materials making up the charge, makes it possible to calculate the carbon in the charge. This calculation is made in the same way as the calculation for silicon, for example, except that there is no deduction made for loss in melting, because in a well-run cupola there is almost without exception a carbon pickup.

Recording Cupola Mixtures

If proper records of cupola mixtures are kept, they will in time be invaluable to the operator in making up mixtures to produce irons of predetermined carbon content and, furthermore, it will enable him to make a graph or graphs showing the total carbon level to be expected in the iron at the cupola spout when the carbon in the charge is known.

All of the cupolas operated by the company with which the author is connected are of the front-slagging type which, of course, means that iron flows from the taphole continuously from start to finish of the heat. At no time is there any appreciable accumulation of molten iron in the well of the cupola, but the small amount which does collect remains at a constant level because it flows out as fast as it is melted. This type of operation results in uniform carbon pickup, which is one of the essentials of carbon control.

Intermittent Tapping

In cupolas which are tapped intermittently the amount of molten iron in the well may range from several tons (in the larger cupolas) to practically none in the few minutes required to make a tap. This means that the depth of iron within the cupola is constantly changing, and under these conditions the carbon pickup is apt to be less uniform than when the metal is removed as fast as it is melted.

It is not inferred that uniform carbon pickup in the cupola cannot be obtained with intermittent tap-

Fig. 5—Section of a 5-in. diameter riser removed from a 21.5-in. I. D. cylinder liner as shown at upper left in Fig. 3. Note Brinell hardness figures range from 217 at the center to 228 near the outer edge. This test piece and the test piece shown in Fig. 4 were from the same casting.

Fig. 6—Cylinder liner in process of machining. Eight of the 12 port openings can be seen.

Table 2

COKE TYPES—ANALYSIS

PERCENTAGE

	By-product	*Beehive*	*Pitch*
Fixed carbon	90.0-92.0	93.0-95.0	98.0 plus
Ash	7.0- 9.0	5.0	0.50
Sulphur	0.6	0.5	0.30
Volatile matter	0.6- 0.9	0.9	1.0

ping, but it requires a little closer supervision. An exact tapping cycle must be established, and the time between taps must then be maintained by means of a stop watch.

Frequently, with intermittent tapping, a cupola tapper can see no harm in allowing the time between taps to vary 10 or 20 or 30 seconds, although actually this may be a high percentage of the established time cycle (between taps) and variations of the magnitude just mentioned may materially affect the percentage of total carbon in the iron tapped, especially in mixtures containing high percentages of steel. For the purpose of carbon control, the company with which the writer is connected has on hand three types of coke, used either singly or in combination. The approximate compositions of these cokes are shown in Table 2.

By-Product Coke

All other things being equal, the total carbon in irons melted with by-product coke is lower than that obtained when using either of the other types, and the pitch coke produces irons higher in total carbon than either of the other cokes,while melting with beehive coke produces irons of intermediate total carbon content.

From this it is obvious that there is an infinite number of possible coke combinations which could be used to help control the total carbon. As an example of the effect of different types of coke on carbon pickup, the comparison between the beehive and by-product types is shown in Table 3.

With mixture "A" the carbon pickup was 1.32 per cent, which is the difference between the average total carbon in the melted iron (3.04 per cent) and the calculated carbon in the charge (1.72 per cent). With mixture "B" the carbon pickup was 1.04 per cent, which is the difference between 3.05 per cent in the melted iron and 2.01 per cent calculated to be present in the charge.

The carbon pickup with mixture "A" may be looked upon as unusually high (as compared to results obtained with mixture "B") inasmuch as it contained 25 per cent more steel and 18.1 per cent less automotive cast scrap calculated at 3.20 per cent total carbon than mixture "B" (these percentages being based on the amounts of materials present in mixture "B"). This difference in carbon pickup is attributed to a large extent to the difference in characteristics of the types of coke used.

From previous experience it has been found that had mixture "A" been melted under identical conditions with 250 lb. of by-product coke (instead of beehive), the total carbon in the iron coming from the cupola would have been in the range of 2.75-2.85 per cent.

Pitch Coke

As an example of the effect of pitch coke on carbon pickup, the comparison shown in Table 4 is given to show the effect of replacing a portion of the beehive coke with pitch coke.

Results of a large number of determinations have shown that when using cupola mixture "C" melted with 300 lb. of beehive coke, the total carbon in the melted iron will fall in the range of 3.00-3.15 per cent, while the same mixture melted with 250 lb. of beehive coke plus 50 lb. of pitch coke will produce irons having a total carbon in the range of 3.25-3.40 per cent.

Other mixtures containing 12.5 per cent southern pig iron (No. 2) and 87.5 per cent cast scrap, when melted with 100 per cent beehive coke in the ratio of 10:1, produce irons having a total carbon in the range of 3.35 to 3.45 per cent, while the same mixtures with the same coke ratio produce irons close to 3.60 per cent total carbon when one-third of the beehive coke is replaced with pitch coke.

Mixtures containing 75 per cent southern pig iron and 25 per cent cast scrap using beehive coke in the ratio of 15:1 yield irons containing slightly above 3.70 per cent total carbon, and these same mixtures when using by-product coke in the same ratio produce irons containing about 3.60 per cent total carbon.

Mechanical Charging

As previously stated, auxiliary cupola equipment plays an important part in control and uniformity of the molten iron. All cupolas in this company's foundries are charged mechanically with the exception of one, which will be changed over as soon as installation can be made.

Mechanical charging usually improves the operation because it is easier to keep the cupola filled to the charging door level at all times during the melting operation, and the types of charging equipment used distribute both the metal and coke in the cupolas in a much more satisfactory manner than is accomplished by hand.

This is especially true with cupolas of larger inside diameters, where charging crews often are prone to place the heavier components of the charge near the charging door opening and in hot weather more of the

Table 3

COKE TYPE EFFECTS ON CARBON PICKUP

Materials	*Mixture "A"** lb.	*per cent*	*Mixture "B"* lb.	*per cent*
Silvery pig iron (8 per cent Si)	100	5	100	5
Steel scrap (No. 2)	1,000	50	800	40
Automotive cast scrap	900	45	1,100	55
Totals	2,000	100	2,000	100
Carbon in charge		1.72		2.01
Coke per charge	250 (Beehive)		250 (By-product)	
Coke ratio	8:1		8:1	
Cupola size	72 in. I.D.		72 in. I.D.	
*Total Carbon***				
Range, per cent	3.00-3.06		3.00-3.08	
Average, per cent	3.04		3.05	

*Mixture "A" contained 4 lb. Si in form of 50 per cent lump to bring Si in both charges to same level.

**In each case total carbon determinations were made on 12 consecutive ladles (2 tons each) of the melted iron.

coke charge than should be is placed near the charging door, in order to protect the "chargers" from heat inside the cupola.

Weighing Equipment. Referring again to cupola mixtures "A" and "B" mentioned in the foregoing, it is pointed out that the results with mixture "A" indicate a total carbon of 3.03 per cent plus or minus 0.03 per cent, and with mixture "B" the total carbon was 3.04 per cent plus or minus 0.04 per cent. This uniformity was accomplished in a large measure by exercising great care in weighing of all the components of the cupola charge.

The steel, an automotive cast scrap, was loaded with a crane and magnet on a 12,000-lb. capacity platform scale. The charging car and bucket weigh 4,000 lb., which, of course, has to be taken into account by the scaleman or weighmaster. Furthermore, this man looks over the materials being charged and sorts out any materials not shown on his charge sheet.

Weighing Cupola Charges

The silvery pig iron (100 lb. per charge) was weighed on a portable platform scale of 500-lb. capacity, and several piles of this material weighed in advance are shown in Fig. 7. The coke was weighed on the same set of scales as was used for the silvery pig iron. The containers are steel drums cut in two and with handles welded to each half. The gross weight is marked on each container and, for convenience and ease of handling, the coke is weighed in batches of 100 lb. or less, as shown in Fig. 8.

The 50 per cent lump ferrosilicon, totaling only 8 lb. per charge, was weighed as shown in Fig. 9 on a 24-lb. capacity spring scale of the type frequently used by housewives around the kitchen. The foregoing procedure, when properly supervised, certainly leaves very little room for doubt regarding the accuracy of weighing of the materials used and the operator is always rewarded with uniformity, not only in total carbon results but in all of the elements involved.

Table 4

EFFECT OF PITCH COKE ON CARBON PICKUP

Materials	*Mixture "C"* lb.	*Mixture "C"* per cent	*Mixture "C"* lb.	*Mixture "C"* per cent
Malleable pig iron	700	35	700	35
Steel scrap (No. 2)	1,100	55	1,100	55
Duriron scrap	100	5	100	5
Manganese steel	100	5	100	5
Totals	2,000	100	2,000	100
Carbon in charge		1.66		1.66
Beehive coke per charge	300		250	
Pitch coke per charge	none		50	
Total coke per charge	300		300	
Coke ratio	6.7:1		6.7:1	
Cupola size	72 in. I.D.		72 in. I.D.	
Total carbon, per cent	3.00-3.15		3.25-3.40	

Cupola Blast Moisture Control

One of the variables of considerable magnitude which affects cupola operations is the moisture content of the air used for the blast. This may vary from 2 grains per cu. ft. on cold winter days to as much as 12 grains per cu. ft. on hot sultry days. The moisture content of the air may also vary within the limits referred to during the course of a single day's melting operation.

There are 7,000 grains in one lb. Now let us consider the possible variation in the amount of water carried into a cupola with the air blast when melting 200 tons per day, as is often the case at one of the plants being discussed. This operation will require about 5,200,000 cu. ft. of air, so that the water blown into the cupola will be between 1,500 lb. (180 gal.) and 9,000 lb. (1,080 gal.).

From these figures it is evident that the control or elimination of a variable of such magnitude is well worth consideration. For this reason equipment for controlling moisture in the cupola blast was installed at this plant.

The installation is designed to remove moisture from 13,000 cu. ft. of air per min. down to 4 grains per cu. ft. in the summer season, and also is capable, in dry weather, of introducing as much as 7 grains per cu. ft.

The principle of operation lies in the fact that the system contains a solution of lithium chloride which, under the proper conditions, has a large capacity for absorption of moisture from the air. However, this absorption capacity can be controlled and predetermined by regulating the temperature of the lithium chloride solution.

Moist air from the outside is taken in through a filter to remove dust and dirt. It then passes through the "contactor cells" in intimate contact with a spray of lithium chloride solution, where moisture is removed (or added) to a predetermined amount within the design limits of the system.

To prevent loss of lithium chloride solution due to carry-over, the air passes next through a series of glass-wool eliminators, and finally is drawn through a set of heating coils and thence to the cupola blower intake. The heating coils maintain the cupola blast at a temperature of 105° F.

When a cupola is operating so as to require 10,000 cu. ft. of air per min. taken into the moisture control system, with 8 grains of moisture per cu. ft. and leaving with only 4 grains per cu. ft., the lithium chloride solution is taking on about 40 gal. of water per hr. To maintain efficient operation of the system, this excess water must be removed continuously and as rapidly as it is absorbed.

This is accomplished in the regenerator unit, where a part of the diluted lithium chloride solution, after being heated to a temperature of 235° F. in the solution heater, is sprayed over a relatively small contactor surface where a small stream of outside air passes over it. At the elevated temperature (235°

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F.) referred to the solution gives up the moisture which was previously removed from the cupola blast.

The lower part of the regenerator unit serves as a storage space for the solution when the system is not in operation, and it also houses a series of filters which constantly remove foreign material from the solution when the system is in operation.

In the winter season it is necessary to add moisture to the cupola blast in order to maintain a year-'round constant control. This is accomplished by means of a small heating coil where the solution is heated with steam to a temperature at which it will give up moisture to the cupola blast in just the amount required to maintain proper control. The principle of operation of the heating coil is somewhat the same as that of the regenerator.

While it so happens that the company with which the author is connected has installed a moisture control system for maintaining a year-'round uniform moisture content of 4 grains per cu. ft. of cupola air blast, this figure in itself is not particularly significant. Whether the system be designed for 2 grains or 5 grains or any other figure, the significant feature is that variations in moisture content of the cupola blast have been eliminated.

It is well to point out at this time that even though the moisture control system is fully automatic in its operation, it requires daily inspection and setting of some of the control valves and thermostats. This is taken care of by a laboratory technician, who spends an average of not more than 30 min. per day to make all adjustments.

Air Weight Control Blower. As previously stated, about 5,200,000 cu. ft. of air are required to melt 200 tons of iron in the cupola. Air at 14.7 lb. psi. atmospheric pressure and 60° F. weighs 0.0764 lb. per cu. ft. It is evident from these figures that for every lb. of iron melted, practically one lb. of air is required. Every effort is made to weigh the metal charges accurately and, to insure uniformity of operations, the air should be weighed accurately.

To this end an automatic air weight control blower was installed. This blower is operated by means of a 150-hp. motor (D.C.) and is capable of delivering 13,000 cu. ft. of air per min. at a pressure of 2 lb. The amount of air delivered to any one of the four cupolas lined to 72-in. I. D. is measured in lb. per min. so that the blower reading in lb. per min. will be close to the melting rate of the cupolas expressed in lb. of metal per min.

The older blowers used by the company are of the positive displacement type. Each revolution delivers a definite volume of air to the cupolas, so that running at a constant rpm. will deliver a fairly constant volume of air.

However, to deliver a constant weight of air to the cupolas with the older blowers would require constant adjustment in speed corresponding to the slightest changes in atmospheric temperature and pressure. For this reason it is obvious that the constant-air-weight-control blower eliminates the variables of constantly changing atmospheric conditions.

Balanced Blast Cupolas. Two of the four cupolas at one of the company's plants and two cupolas at another plant are of the balanced-blast type, each equipped with one row of main tuyeres and two rows of auxiliary tuyeres. The main tuyeres are provided with slide valves so that they may be opened or closed at will during the course of the heat.

Two of the main tuyeres diametrically opposite are closed at the same time so that the area directly in front of them is heated to a temperature sufficiently high to melt off all overhanging slag. After 8 or 10 min. these are opened and two others are closed. This procedure is continued throughout the duration of the heat and results in the prevention of bridging and blocking up of the main tuyere openings.

The openings of the auxiliary tuyeres are adjustable, but the settings cannot be changed without shutting off the cupola blast. The upper, or auxiliary tuyeres, bring about more complete combustion of the coke and thereby make possible a more efficient cupola operation, and in conjunction with the controllable main tuyeres the balanced-blast cupolas melt somewhat faster and at higher temperatures with the same coke ratios than the cupolas

Fig. 7—Silvery pig iron (100 lb. per charge in this case) being weighed in advance on portable platform scales. Note several piles at right ready to be placed in charging buckets.

Fig. 8—Coke charges are weighed on same platform scales as shown in Fig. 7. Gross weight is marked on each container.

Fig. 9—Small 24-lb. capacity spring scale is used to weigh 50 per cent lump ferrosilicon when used in small amounts (8 lb. in this case).

provided with tuyeres of the conventional type.

Processing the Iron. As previously stated, all of the cupolas operated by the company are of the front-slagging type. Molten iron from the cupolas runs directly into forehearths or teapot ladles, where an amount equivalent to several cupola charges is stored and mixed, resulting in greater uniformity of metal composition than would be obtained when tapping directly from the cupola into the pouring ladles.

This is especially true when the capacity of the pouring ladles is small (1,000 lb. or less). The size of the forehearth ladle is such that it will hold as much molten iron as the cupola melts in 10 to 15 min. From this it is obvious that different sized forehearth ladles are used with different sized cupolas.

While the forehearth is being filled with molten iron and after each ladle is taken out, the metal (in the forehearth or teapot ladle) is treated with fused soda ash for the purpose of reducing the sulphur content, removing entrained silicates, increasing fluidity, and for deoxidation and grain refinement.

As the metal is transferred from the forehearth or teapot ladle to the pouring ladles, it is inoculated in all cases with a minimum of 0.2 per cent (2 lb. per 1,000 lb. of molten iron) of zirconium silicide, which is an alloy containing 35-40 per cent zirconium and 50 per cent silicon. This is an excellent scavenger and deoxidizer.

In addition to this, 75 per cent grade ferrosilicon also is added, as all of the mixtures are calculated with the silicon content in the iron at the cupola spout somewhat (0.20-0.40 per cent) below that desired in the final product, thus deliberately leaving room for a "late" addition of ferrosilicon. This type of operation has a very distinct advantage in that it makes it possible to pour castings varying widely in section size from the same "base" iron.

This is done by adjusting the cupola mixture to "fit" the castings having the heavier metal sections. For lighter castings varying amounts of ferrosilicon are added, and for the heaviest castings very little ferrosilicon and varying amounts of ferrochromium or one of the stabilizing types of inoculants may be added. In addition to those just referred to, other alloys and inoculants are added to the molten iron when necessary.

Inoculant Types

These may be either the graphitizing type or the stabilizing type. When producing high-strength irons for use in thin-walled castings, double inoculation often is resorted to, the purpose being to facilitate machining. Double inoculation consists in making additions of both the graphitizing and stabilizing types, and has been a very successful procedure especially in cases where low-carbon-equivalent irons are used.

All of the ordinary alloying elements such as nickel, chromium, molybdenum, copper, titanium and vanadium may be used separately or in combination, depending upon the

Fig. 10—Caustic pot made in accordance with the process described in the text. Inside diameter, 10 ft. 3¾-in.; height, 8 ft. 3 in.; weight, 30,000 lb. Metal section ranges from 2½-in. near top to 3½-in. in bottom. Chemical composition in percentages: silicon, 1.04; sulphur, 0.054; manganese, 0.90; phosphorus, 0.12; total carbon, 3.81.

class of iron to be produced, the particular application, or the customer's specifications. The purpose of the use of inoculants is to control the structure of the iron in the castings, that is, to produce irons having a pearlitic matrix, free of ferrite, with graphite flakes in random distribution.

From each ladle of iron a chill-test specimen is poured which is used as a guide and quick checkup for the cupola operator. The size, or dimensions, of the chill-test specimen will depend upon the composition of the metal, and this in turn is governed by the size and type of castings to be poured. All chill-test specimens are poured against water-cooled, copper chill blocks so that chill depth is not affected by variations in the temperature of the chill block.

As a further aid to the cupola foreman, strict laboratory control is maintained at all times. When the cupolas melt one type or "grade" of iron for several hours in succession, samples for complete chemical analysis go to the laboratory hourly.

Results of total carbon determinations are returned to the cupola foreman within 10 min. and the silicon, sulphur, manganese, and phosphorus are reported as soon as

they have been completed. This usually requires 45 min. to one hour. Two sets of test bars (2 per set) are poured daily from each type of "regular" iron.

When producing high-strength irons, certain irons made to customers' specifications, and practically all special castings, test bars and samples for laboratory analysis are poured from each ladle. The bars are handled in the physical testing laboratory, where transverse strength, deflection, and Brinell hardness are determined.

Tensile-test specimens are machined, on a lathe set up in the laboratory especially for this purpose, from the halves of broken test bars, and tensile strengths are determined in the usual manner. The laboratory is of ample size and has adequate facilities for handling large numbers of samples for complete chemical analysis, and is equipped to make all of the physical tests required to furnish complete data on all castings produced.

Likewise, there is a complete microscopic laboratory with darkroom facilities. These are used constantly for visual examination of the structure of the irons, and in certain instances photographic records are kept.

Producing High Quality Cast Iron. A series of custom-made, high quality cast irons (patented) is produced by the foundries with which the author is connected. The method of manufacture is based upon the use of synthetic pig iron containing a maximum of 0.20 per cent of phosphorus. This pig iron is made by melting down a cupola charge consisting of 100 per cent steel scrap or other ferrous materials containing relatively small percentages of silicon and carbon, such as malleable scrap or any combinations of these materials.

During the melting process, in the cupola, the charges absorb upward of 3.00 per cent of carbon, and thus the iron tapped out will have a composition generally falling within the following limits:

Component	*Per Cent*
Silicon	0.10-0.40
Sulphur	0.10 max.
Manganese	0.20-0.40
Phosphorus	0.20 max.
Total carbon	3.10-3.50

This iron is collected in a 10-ton capacity teapot ladle where several of the cupola charges are mixed in order to obtain uniformity throughout the bath of metal. From time to time, during the melting process, ladles of iron are taken out of the teapot ladle and poured into ingot molds. During this transfer of molten iron from the teapot ladle to the pouring ladle, additions of silicon, manganese, zirconium or any other elements ordinarily used may be made.

However, this is optional and is governed by the end product for which the metal is to be used. Upon solidification the ingots are removed from the molds and taken to the iron yard, where they are broken into pieces of suitable size for recharging into the cupolas for the second and final melting operation.

Brief examination of the analysis of the iron as tabulated in the foregoing will make evident the fact that this metal remelting can, by means of proper additions to the cupola charge, be made suitable in composition for use in castings of any metal section whatsoever.

Cupola Charge Additions

Where relatively low-silicon-high-carbon irons are required, relatively small additions of materials high in silicon will be added to the charge. No "raw" steel will be used, so the final product will be relatively high in total carbon content, that is, in the range of 3.45 to 3.90 per cent.

The manganese can be held at any desired level, and in some instances has been deliberately kept as low as 0.20 per cent. This was in iron for a number of large caustic pots (Fig. 10) where manganese in the normal range of 0.70-1.00 per cent was found to impart an objectionable color to the finished product.

Ordinarily, irons of low-silicon and high-carbon contents are used, as previously stated, for caustic pots, kettles, jackets, covers, autoclaves, ingot molds, and a variety of other shapes used in chemical industry. This type of iron is soft and resistant to heat shock as well as to grain growth in applications where castings are subjected to elevated temperatures (below the critical) for long periods of time.

When iron made by the foregoing methods is used for castings requiring a high-strength iron, the cupola charges will contain synthetic pig iron (previously described) and the percentage of steel deemed necessary for the class of iron being produced.

From the foregoing description of the process it is evident that any class of high quality iron can be produced, ranging in tensile strength from 25,000 to 60,000 psi. All operations relating to the cupola practice are carefully controlled and supervised as previously described.

One of the chief differences between irons produced by this method and the other irons produced lies in the fact that up to 1.5 per cent (30 lb. per ton) of zirconium silicide frequently is used as a ladle inoculant and, while this alloy ordinarily is looked upon as a graphitizer, additions even in very large quantities do not result in the formation of ferrite in the microstructure. Any of the alloys ordinarily used in cast iron may be used in iron produced by this method if and when the occasion demands.

Northern California Publishes Sand Data

THE SECOND REPORT of the Northern California chapter's Sand committee, "Foundry Sands and Mold Materials, Report No. 2," has just been published in booklet form. The first report was published early in 1945 and met with such success and demand that the committee decided to continue its study of sand problems.

Copies may be obtained from the Northern California chapter by addressing requests to J. F. Aicher, E. A. Wilcox Co., San Francisco.

The general chairman of the Sand committee responsible for Report No. 2 is W. W. Clark, Enterprise Engine & Foundry Co., San Francisco; vice-chairman, Geo. W. Stewart, Pacific Brass Foundry of San Francisco. Donald L. Mason, Leland Stanford University, Palto Alto, Calif., acted as technical advisor.

Chairmen of the subcommittees: Iron—Harold E. Henderson, H. C. Macaulay Foundry Co.; Steel—Milton Oakes, American Manganese Steel Div., American Brake Shoe Co.; Magnesium—Thomas W. F. Foster, Permanente Metals Corp.; Non-Ferrous—Wm. Burt, Berkeley Brass Foundry Co.; Supply and Service—H. M. Donaldson, Brumley-Donaldson Co.

HIGH TEMPERATURE SAND TESTING

Fifth Annual Progress Report

D. C. Williams
A. F. A. Fellow
Cornell University
Ithaca, N. Y.

A BRIEF DESCRIPTION is given of a newly constructed furnace for elevated temperature research on the hot compressive and hot transverse strength of foundry sand test specimens.

Green hot compressive strength-specimen exposure time data for eight sand mixtures (mixture additions, western and southern bentonites, fire clay, cereal and silica flours) having 5 per cent moisture is shown for temperature control settings of 1600°, 2000° and 2500° F. This required the testing of 1119 specimens.

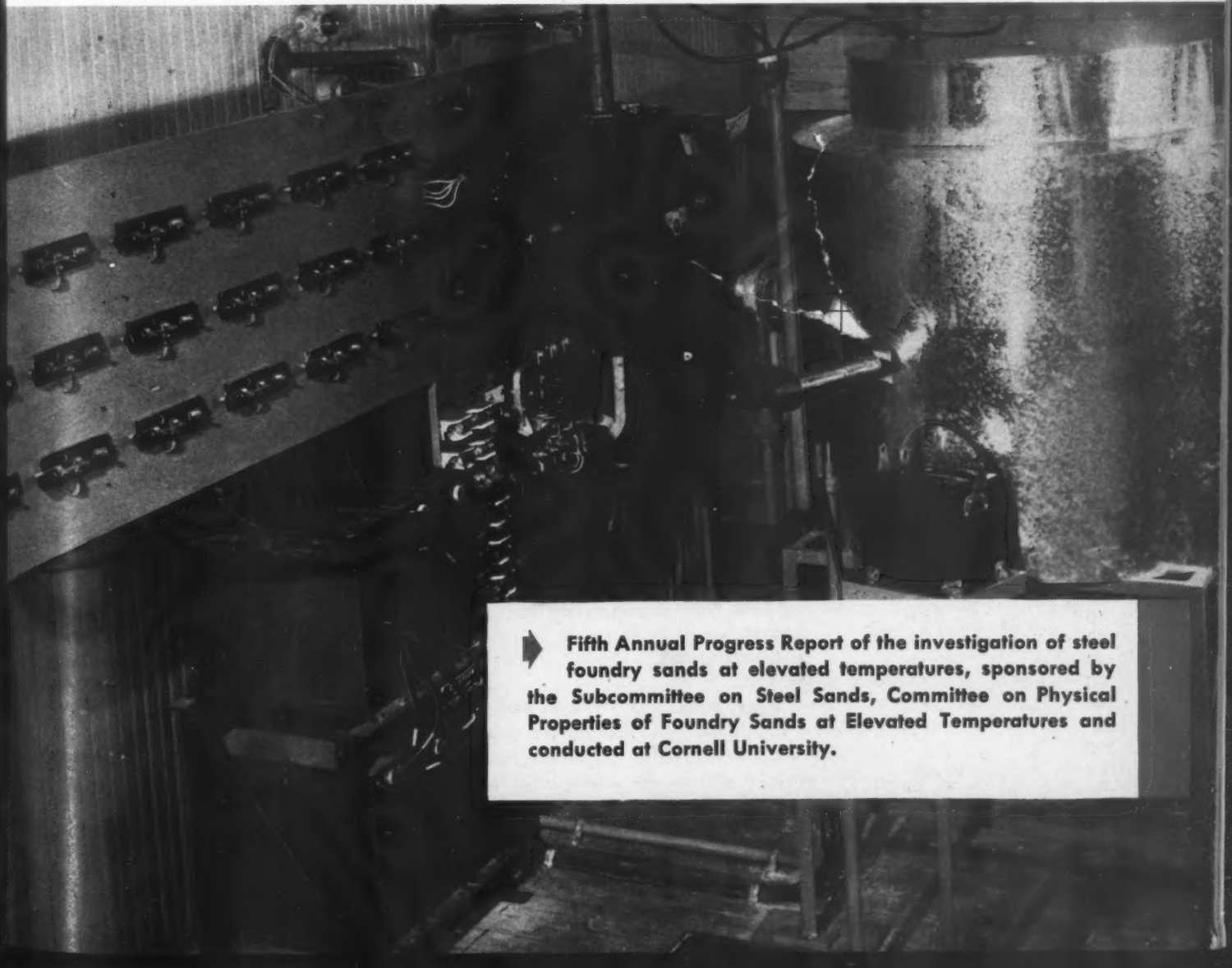
The addition of silica flour to the two kinds of bentonite mixtures increased the maximum and minimum hot compressive strength of the test specimen, whereas the addition of cereal flour did not appreciably affect these strengths at most of the temperature control settings (tendency toward lower strengths.)

The maximum hot compressive strengths for all test specimens occurred at temperature control settings of (1) 1600° F. for the bentonite mixtures and (2) 2000° F. for the fire clay mixtures. The minimum strengths for all mixtures occurred at 2500° F. and were substantially zero psi.

Little difference was found in the minimum hot compressive strength of the test specimen for fire clay and southern bentonite mixtures alone and when cereal flour was added.

Stress-strain data indicate it is desirable to load the test specimen at a constant strain rate. The maxi-

Fig. 1—New elevated temperature research furnace at Cornell University.



Fifth Annual Progress Report of the investigation of steel foundry sands at elevated temperatures, sponsored by the Subcommittee on Steel Sands, Committee on Physical Properties of Foundry Sands at Elevated Temperatures and conducted at Cornell University.

Table 1

SAND MIXTURES TESTED

	Composition, per cent					
Mixture No.	*Sand*	*Western Bentonite*	*Southern Bentonite*	*Fire Clay*	*Cereal Flour*	*Silica Flour*	*Moisture*
1	96	4	....	....	....	....	5.4
2	86	4	....	....	....	10	5.0
3	95	4	....	....	1	....	5.2
4	96	....	4	....	....	....	5.2
5	86	....	4	....	....	10	5.2
6	95	....	4	....	1	....	5.2
7	96	....	....	4	....	....	5.2
8	95	....	....	4	1	....	4.8
9	93	....	....	7	....	....	5.0

mum strain value for the western bentonite mixture was approximately twice the maximum value when silica and cereal flours were added to the bentonite mixtures.

During 1944, a change in the committee set-up for elevated temperature investigations took place. The work being done at Cornell University now is sponsored by the Subcommittee on Steel Sands, Committee on Physical Properties of Foundry Sands at Elevated Temperatures. During 1944, this work covered two phases: (1) the building of a piece of elevated-temperature testing equipment for research, and (2) the initiation of the foundry mixes program. H. W. Dietert presented a 1944 model of his dilatometer to the A.F.A. and it was installed at Cornell University to be used primarily in conducting the foundry mixes program. Werner Finster, chairman of the subcommittee, before the change in organization, wrote the following to the subcommittee regarding the new dilatometer and the foundry mixes program: "It was the thought of the officers of the subcommittee that the second dilatometer would be used as furnished by H. W. Dietert, and that sand mixtures, changing only one variable at a time, would be tested on this dilatometer. While it must be understood that data developed in this manner will only represent information as developed on this particular instrument, results of this investigation should be of help to the industry, which also is using commercial dilatometers."

Table 2

SCREEN ANALYSIS OF BASE SAND

U. S. Bureau Standards Sieve. No.	*Per Cent Retained*
40	0.51
50	10.15
70	40.95
100	35.40
140	10.90
200	1.92
270	Trace
Pan	Trace
	99.83

New Research Furnace

Four needed requirements for a research instrument to investigate foundry sands at elevated temperatures are: (1) means of observing the test specimen at all times during exposure to heat, (2) furnace heat capacity great enough so that the introduction of the test specimen into the furnace would cause a negligible temperature drop, (3) an air-free hydraulic pressure-loading system and (4) a piece of testing equipment with sufficient capacity to also conduct a transverse test at elevated temperatures.

In an attempt to satisfy the above requirements, B. A. Bovee, Carborundum Co., Niagara Falls, N. Y., designed a silicon carbide resistor furnace. The new furnace, Fig. 1, was built at Cornell University. The pressure-loading equipment is not shown because of difficulties in obtaining the necessary parts. At the present writing, the furnace has been taken through the preliminary heating up and it appeared that no trouble would be found in reaching a temperature of 3100° F. when desired.

When making a strength test, it is highly desirable that the test specimen be observed at all times. To be able to see just how cracks form may be valuable information. For research purposes, it is necessary to eliminate a furnace temperature drop if possible. The new research furnace has at least nine times the heat capacity of the commercial dilatometer furnace.

On the new research furnace the rate of table rise will be variable. A change in rate can be obtained by opening or closing a by-pass valve to the reservoir. It will be necessary to make the new hydraulic system air free.

When using silicon carbide heating elements, it is highly desirable that the electrical energy input be continuous. The electrical energy required to just about maintain a temperature control setting will be regulated manually. An additional small amount of the electrical energy input will be regulated automatically to maintain a temperature control setting. Capacitors (ordinarily used for power factor control) are used to regulate the energy input.

The specimen will be introduced into the furnace by means of a refractory skid. This skid is so arranged that it will be possible to alternate between a compression and a transverse test, as desired, without a time delay. The maximum size of the specimen that can be handled will be 2½-in. diameter or 2½-in. on one side and 6 in. long.

Foundry Mixes Program

The hot compressive strength results reported in the following are the beginning of this program. Succeeding progress reports will contain continuations of these studies.

The results for sand mixtures given in Table 1 were obtained under the following conditions:

(1) A 1944 model commercial dilatometer was used for all tests.

(2) A controlling thermocouple

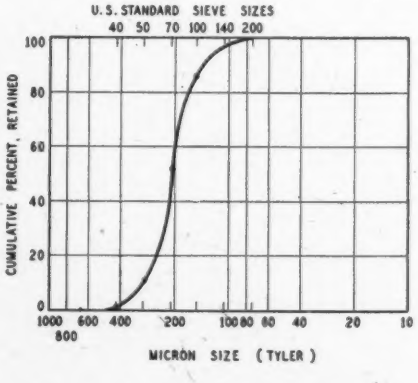


Fig. 2—Cumulative distribution curve for sand used for foundry mixes program.

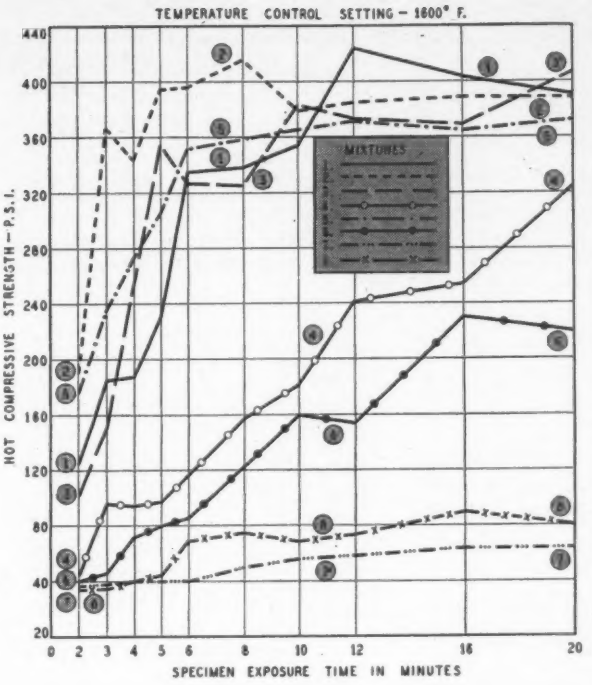


Fig. 3—Relation between hot compressive strength and exposure time on mixtures shown in Table 1, tested at 1600° F.

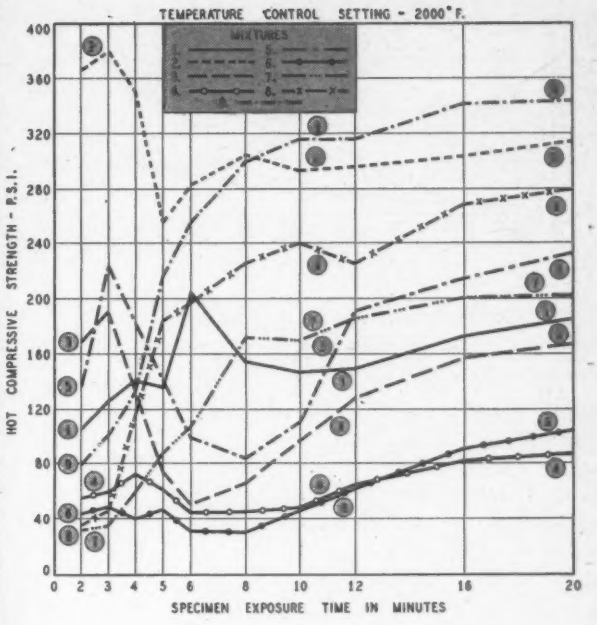


Fig. 4—Relation between hot compressive strength and exposure time on mixtures shown in Table 1, tested at 2000° F.

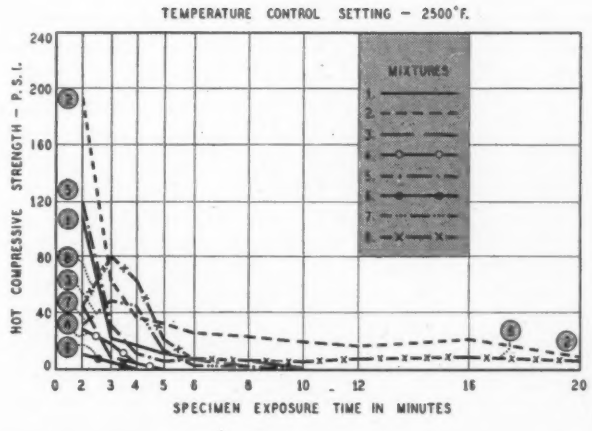


Fig. 5—Relation between hot compressive strength and exposure time on mixtures shown in Table 1, tested at 2500° F.

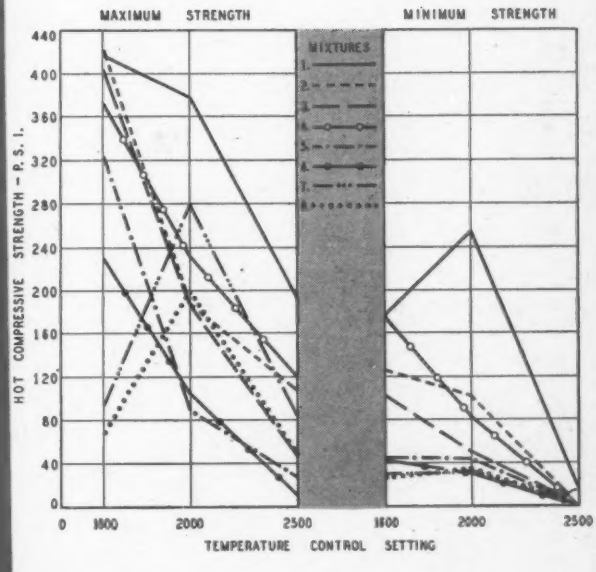


Fig. 6—Relationship between furnace temperature and maximum and minimum strengths obtained at different exposure times.

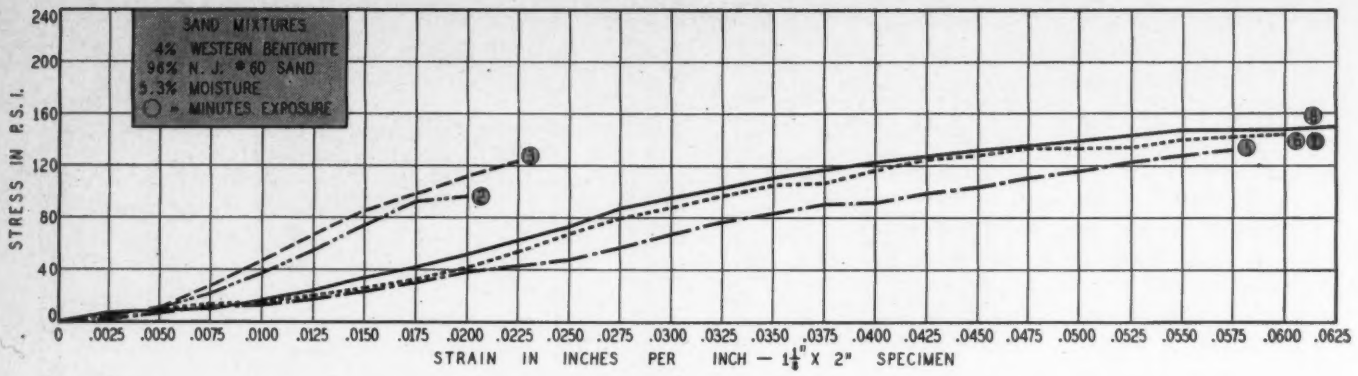


Fig. 7—Stress-strain diagram for Mixture 1, Table 1.

(platinum vs. platinum-10 per cent rhodium) had its bare hot junction located opposite the center of the specimen and inside the heating chamber.

(3) A double bore fused quartz thermocouple protecting shield. This type of protecting shield was used because: (a) it is transparent to most of the radiant heat; (b) for any chosen recovery time, the overheating of the element temperature was reduced approximately one-third, and (c) less impressed voltage was required to obtain a chosen recovery time.

(4) Refractory disks (mullfrax "S") 1-in. thick and 1⅜-in. diameter were used. These disks were used because: (a) they covered the expanded surface of the heated test specimen, (b) their thickness insured the conducting of a compression test upon the test specimen, and not a transverse test upon the disk, and (c) that the heat absorbed by the test specimen was not dissipated through the disk.

(5) The controlling thermocouple recovery time ranged from 2 min. 15 sec. to 2 min. 45 sec.

(6) The pump motor was started so that contact between the upper post and top disk was made within plus or minus 2 sec. of a given exposure time (contact indicated by a rise in gage pressure).

(7) Trapped air in the hydraulic pressure system could not be removed; evidence of trapped air was indicated by a sudden plunger jump when the test specimen ruptured.

(8) All tests were made using green sand specimens.

(9) All test specimens were 1⅛-in. diameter and 2 in. long, being molded in a split specimen tube.

(10) Hot compressive strength tests were made at furnace control temperature settings of 1600, 2000 and 2500° F.

(11) The silica sand used had the mechanical analysis shown in Table 2. Figure 2 shows the cumulative curve for this sand.

(12) The total weight of dry materials or each batch mixed was 10 lb. or 4500 grams. The mixing was carried out in a 24-in. laboratory mixer (revolving muller type) and the batches were mixed 2 min. dry and 5 min. after the distilled water was added. The hot compressive strength testing was started immediately after mixing.

(13) The mixtures tested are shown in Table 1. The numbers of the mixtures correspond to the numbers of the curves, showing the rela-

Table 3

VARIATIONS IN HOT STRENGTH (PSI.) OF VARIOUS SAND MIXTURES WITH EXPOSURE TIME (AVERAGE OF FIVE TESTS) (EXPOSURE TEMPERATURE, °F.)

Exposure Time, Min.	*Mixture 1*			*Mixture 2*			*Mixture 3*		
	1600	*2000*	*2500*	*1600*	*2000*	*2500*	*1600*	*2000*	*2500*
2	127	104	108	176	365	194	101	165	46
3	186	126	21	369	380	62	152	190	7
4	188	140	17	346	352	35	253	136	4*
5	234	134	10	395	252	32	357	73	0
6	336	206	7*	397	283	26	327	50	0
8	339	153	6	415	306	24	325	66	....
10	356	146	2	379	294	20**	382	98	....
12	425	148	0	386	297	17	374	128	0
16	404	173	....	391	304	22	370	158	....
20	391	183	0	389	316	10	396	168	....
	Mixture 4			*Mixture 5*			*Mixture 6*		
2	44	53	27	176	135	120	41	42	11
3	97	59	19	235	225	32	46	50	7
4	95	72	4	275	182	8	73	40	0
5	99	61	0	305	142	6	81	50	....
6	118	43	0	352	98	7	88	32	0
8	148	44	0	359	84	2**	123	34	0
10	185	48	....	367	110	0	161	45	....
12	244	64	0	366	191	0	156	65	0
16	256	82	....	374	216	....	232	92	....
20	326	84	....	373	232	....	222	106	....
	Mixture 7			*Mixture 8*			*Mixture 9*		
2	36	31	29	37	33	42	78		
3	36	34	47	38	45	81	99		
4	40	59	45	40	113	61	142		
5	40	87	12	49	183	20	218		
6	41	108	4	71	197	9	256		
8	51	172	0	76	227	4	299		
10	57	170	0	70	241	5	316		
12	58	177	....	76	226	7	320		
16	64	202	....	92	270	8*	343		
20	64	204	....	84	280	4**	345		

* Four tests.
** Three tests.

tionship between exposure time and hot compressive strength.

(14) The moisture content of the mixtures tested varied from 5.0 to 5.4 per cent, with one exception of 4.8 per cent.

(15) Each point plotted represents an average of five tests except when the strength was zero and three tests were made. Average test results are shown in Table 3. A total of 1119 tests were made in order to plot the curves of Figs. 3, 4, and 5.

Figure 6 shows the relationship between the furnace temperature control setting and the maximum and minimum strengths obtained during exposure periods of 2 to 20 min. The following points may be noted:

(1) The maximum strength for all bentonite mixtures tested occurred at a temperature control setting of 1600° F.

(2) The maximum strength for all fire clay mixes tested occurred at a 2000° F. temperature control setting.

(3) With the exception of mixture No. 2 the minimum strength curves show decreasing strength as the temperature control setting is raised from 1600 to 2000 to 2500° F.

(4) The addition of 10 per cent silica flour to a 4 per cent western bentonite mixture did not increase the maximum hot compressive strength at a temperature control setting of 1600° F. At temperature control settings of 2000° and 2500° F. the silica flour addition approximately doubled the maximum strength.

(5) The addition of 10 per cent silica flour to a 4 per cent southern bentonite mixture increased the maximum and minimum hot compressive strength at all temperature control settings.

(6) The addition of 1 per cent cereal flour to 4 per cent western and southern bentonite mixes generally indicated some change in the maximum hot compressive strength. In some instances the reduction or increase in strength is slight.

(7) The addition of 1 per cent cereal flour to a 4 per cent fire clay mixture increased the maximum hot compressive strength at all temperature control settings. No change was noted in the minimum hot compressive strength at any temperature control setting.

(8) As a temperature control setting of 2500° F., all the mixtures tested had very little or zero minimum hot compressive strength.

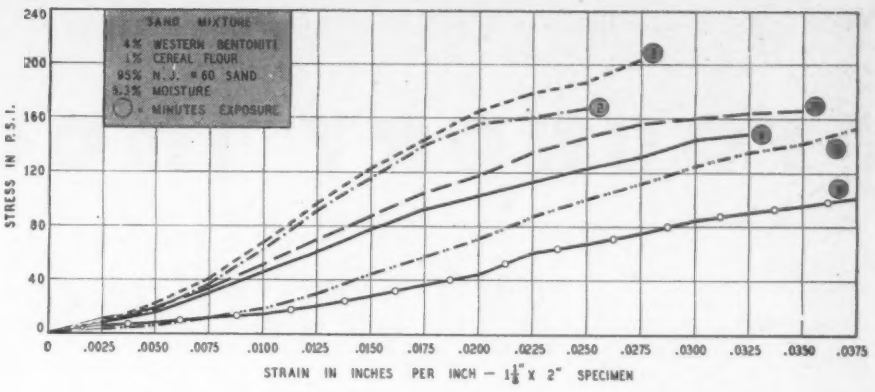
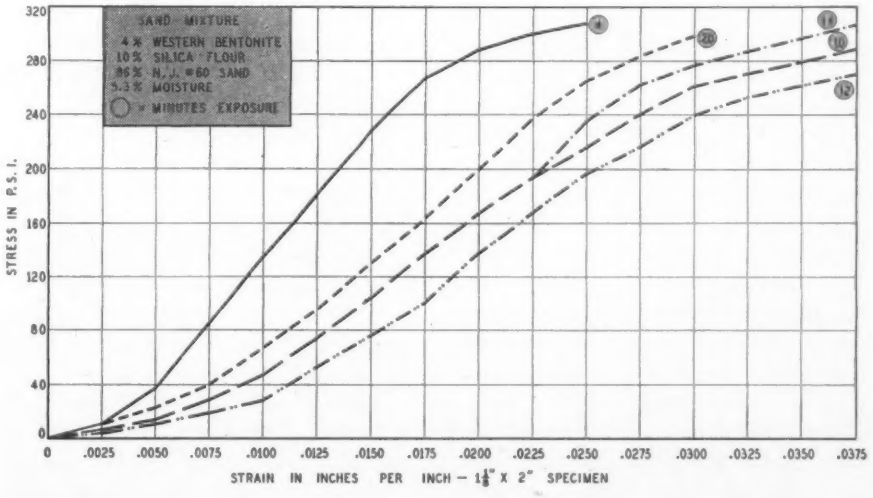


Fig. 9—Stress-strain diagram for Mixture 3, Table 1.

Fig. 8—Stress-strain diagram for Mixture 2, Table 1.



Stress-Strain Curves

Stress-strain data for mixtures 1, 2 and 3 (sands bonded with combinations of western bentonite, cereal and silica flours) will be found plotted in Figs. 7, 8 and 9. Each point shown represents an average of three to five determinations, and all tests were made at a temperature control setting of 2000° F. The strain values were obtained from the rise of the dirt pan and the values of strain were recorded just prior to the indication of stress in order to determine zero strain.

The initial slope of the curves indicates that at low values of stress there is a compacting of the test specimen.

The shape of the curves indicates that it is desirable to load the test specimen at a constant strain rate.

The final strain value for mixture No. 1 was almost twice the final strain value for the other two mixtures, indicating that the former was definitely more plastic.

A study of the distribution of test data has been started and probably will be completed in time for the next annual report.

Acknowledgments

The writer wishes to express appreciation to Professor J. R. Moynihan for his advice and encouragement; to Dr. H. Ries for his continual interest and support. Also, the writer appreciates the assistance of Miss Saville Maney and Mrs. M. T. Richards in obtaining the stress-strain data. The writer wishes to thank A. W. Jenkins, D. Bacon, S. W. Cross, B. P. Fisher and S. Patch for their advice and assistance in constructing the new research furnace.

The writer wishes to thank the Carborundum Co., Globar Div., for supplying the heating elements, and the Cornell-Dubilier Corp., for supplying the capacitors for the furnace.

The sand used for the foundry mixes program was supplied by the New Jersey Silica Sand Co.

FOUNDRY INDUSTRY AND EDUCATIONAL INSTITUTIONS

Arthur J. Tuscany
Executive Secretary
Foundry Equipment Mfgrs. Assn.
Cleveland

MANY INSTANCES have been reported where educational institutions and industries have developed a co-operative program for mutual benefit. Forward looking educational organizations recognize their responsibility and opportunity for service through a properly conceived program of this kind.

The foundry industry is no stranger in co-operating with educational institutions for the benefit of all who will receive assistance through this type of work. There are many cases of co-operation, some of years standing. Examining the results, however, in the light of changing conditions and perhaps from the viewpoint of what might be done to improve conditions as indicated by the returns achieved by other industries from similar work, there appears to be some opportunity for increased values in that direction.

Recognizing the value to be derived from co-operation with educational institutions, the Public Relations Committee of the Foundry Equipment Manufacturers Association, under the chairmanship of Bruce L. Simpson, president, National Engineering Co., proposed as one of its first activities, contact with a group of the leading educational institutions of the country with the primary purposes of determining (a) what methods of operation now are in effect in individual institutions; and (b) the possibilities for a closer working arrangement for the important postwar era.

The board of directors of the Foundry Equipment Manufacturers Association quickly approved the plan and work was started by contacting 600 of the outstanding educational institutions in the country.

It should be noted that these institutions were the better known schools in their respective categories. In considering the results of the survey, this fact should be borne in mind and due allowance made in applying the possible results over the entire list of educational institutions, competently estimated to embrace a total of approximately 30,000. It is felt that many of these could or should have an interest in the foundry field.

A letter was addressed to each of the 600 organizations by the Foundry Equipment Manufacturers Association over the signature of its executive secretary. With this letter was enclosed an information form in duplicate, one copy of which was to be returned to the FEMA. The information form was quite complete and asked for much pertinent information. There was no follow-up employed and the returns which ensued were entirely the result of the one mailing. A tabulation of the return is shown in Table 1.

It will be recognized that the number of responses to the inquiry was quite satisfactory. Sufficient representative information was received from every section of the country and each type of organization to supply a fine background.

A detailed consideration of the responses to each of the eight general questions and subdivisions contained in the confidential information sheet reveals much in the way of interesting, helpful data.

To the first question under Section 1, *"Has your school a mechanical department which instructs in the science of foundry practice?"* 81 answered yes; 35 no. In answer to the request for a brief description of this phase of their activity 14 reported that work in this direction was included under the mechanical engineering department; 5 reported the work was under the metallurgical or metallography department; 14 reported this activity was included in electrical and aeronautical engineering courses; 2 indicated foundry practice was taught under the industrial arts department; 18 have a so-called foundry course or operate their own foundries; 1 conducts classes at local foundries.

In answer to the query under Section 1 *"If not, would you be interested in establishing such a department?"* 25 reported yes; 13 no; and 3 perhaps.

To the first question under Sec-

Table 1

RETURNS RECEIVED FROM STUDY

Number of pieces mailed	600
Total responses received up to May 1, 1945	260
Educational institutions reported closed	3
Institutions not interested in subject matter but willing to show any movies made available	4
Usable responses	253
Institutions reporting "not interested"	127
Interested institutions which furnished pertinent data	126

tion 2. *"Has your school a laboratory foundry for instructional purposes?"* 61 answered yes; 49 no.

The next query was *"If so, please describe, advising capacity and future needs."* Because of the importance of these responses, a tabulation is shown at the end of this paper.

Section 3 indicated to recipients that there is a possibility of foundry equipment being made available to educational institutions. With the attitude of governmental departments having been indicated to be favorable toward placing much of the equipment in educational institutions for instructional purposes, this question seemed important.

It should also be recognized that instruction of the kind in which the foundry industry has such a vital interest can best be achieved through the use of actual equipment under classroom conditions.

To the pointed question *"Would your school be interested in acquiring equipment of this type?"* 92 answered yes; 60 no. By reason of its importance, this section of the inquiry form asked recipients to indicate by the prefix 1 to 9 the order of importance of the type of equipment listed, as far as their interest was concerned. The results were so revealing and important to the foundry industry that a complete breakdown of responses received is contained in Table 2.

Table 2

TYPES OF EQUIPMENT DESIRED

	Order of Importance									No number preference given
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	
Casting cleaning equipment	5	2	4	7	8	9	7	6	5	19
Coremaking machines and ovens	4	9	11	12	9	6	2	5	2	23
Dust arresting equipment	1	3	0	2	4	3	7	13	13	14
Foundry supplies	13	9	5	6	6	7	5	4	5	23
Materials handling equipment	1	2	5	1	2	4	14	8	7	11
Melting equipment, including ladles	22	12	12	5	5	4	2	0	1	25
Molding machines	8	13	8	11	9	4	2	0	3	24
Sand preparation equipment, including mixers	3	13	10	8	10	7	4	3	1	24
Testing machines	20	7	7	5	5	8	1	4	4	21

Melting Equipment Wanted

It will be noted that melting equipment received the greatest number of first choice votes, with testing machines second, foundry supplies next, and then molding machines, casting cleaning equipment, coremaking machines and ovens.

In the second choice column, molding machines and sand preparation equipment both received 13 designations, with melting equipment running a very close second with 12. Foundry supplies and coremaking machines and ovens received 9 each, and testing machines 7.

Table 2 presents some extremely interesting information and undoubtedly indicates several trends. One would seem to be the desire of educational institutions to be better equipped to give practical instruction on major foundry equipment. This is important and is an encouraging sign from the foundry industry standpoint.

Section 4 of the inquiry requested information as to the ability of the educational institution to acquire the desired equipment under one of four suggested methods of procedure. The results are described in Table 3.

By reason of the attitude of governmental departments having been indicated as favorable toward making surplus war equipment available to educational institutions on an attractive basis, the position of the schools and colleges as indicated by the results in Table 3 would seem to suggest closer attention to this particular phase of the subject in the days immediately ahead.

Section 5 of the inquiry dealt with that important subject of methods of instruction, teaching aids and textbooks used. In answer to the first question under this section, *"Do you use models, drawings, or other foundry teaching aids?"* 70 advised that they did; 27 responded that they did not. The next question under Section 5 asked for a description of the individual organization's procedure. Table 4 outlines the responses received to that question.

Considerable discussion has taken place in the past with reference to the textbooks which organizations use in instruction in foundry practice. The next query under Section 5 of the inquiry form asked *"What textbooks do you use?"* Table 5 sets out the detailed answers.

Responses suggest an important question pertinent to the success of work of the kind under discussion, namely, *"Should the foundry industry give attention to the preparation of a series of textbooks for the use of educational institutions in their foundry instruction work?"* Probably a series of textbooks dealing with different phases of the question would be the best answer to the evident need which these responses seem to point out.

The next query under Section 5 was *"What other foundry aids do you use?"* Table 6 gives the response to this question which sets out some interesting information.

To the next question *"If a motion picture on foundry practice was made available, without cost, would you be interested?"* 104 responded yes; 2 replied no.

In answer to the question *"Does your school have talking motion picture projection equipment available?"* 101 responded yes; 5 no. Eighty reported they used silent projection equipment, 3 reported no.

Table 3

BASIS OF ACQUIRING EQUIPMENT

	Yes	*No*
Pay purchase price	3	36
Need educational discounts	37	13
Purchase at factory cost only	29	14
Install if made available without cost	91	3

Table 4

FOUNDRY INSTRUCTION TEACHING AIDS USED

Models, drawings	23
Defective castings	7
Sample materials, cutaways	9
Slides, motion pictures, audio visual aids	19
Demonstrations, charts, blueprints	11
Patterns, some wood, molds, core boxes	17
Improvised equipment	1
Take classes to local foundries	1
Shop drawing illustration and illustrated foundry material	2

In passing it should be observed that educational institutions, certainly in foundry instructional work and perhaps in their work in other directions as well, are inclined definitely toward the use of motion picture equipment. This suggests that the foundry industry be prepared to meet this trend through the availability of motion pictures which will carry the desired message to young men in educational institutions.

The final question under Section 5 of the inquiry was *"Would you be interested in local foundrymen lecturing to your classes?"* 76 responded yes; 17 no.

Section 6 requested information on *"How many full-time foundry or allied subject instructors are on your staff?"* The responses indicated that a total of 98 full-time instructors are employed by 52 schools. The information showed that 47 part-time instructors are employed by 35 schools.

The responses to these two questions would seem to indicate the organizations that have taken foundry instruction work seriously have come to the conclusion that informed instructors are a requisite to the success of their program. This in turn poses a very interesting question to the foundry industry. It has to do with the availability of trained individuals to instruct in foundry courses. The foundry industry would seem to be well advised to be giving thought to the development and completion of a program which will insure the availability of qualified foundry instructors if and when educational institutions require them.

Section 7 of the form asked *"Describe how we could assist by interesting local plants in your problem."* Table 7 details the responses received to this section of the inquiry.

Looking to the future the question was asked *"Will your school sponsor courses for service veterans?"* Eighty-four advised yes; 2 no. This was followed with the inquiry *"If yes, Day"* to which 77 responded affirmatively and under *"Evening"* 27 responded yes. Five institutions were uncertain and 9 planned to include some provision in this regard in the regular curriculum.

The final question of the study was *"What other suggestions do you have as to how we could assist?"* Table 8 gives detailed information on the responses received.

It will be noted that the desire for equipment and advice as to its availability heads the list of the responses under this return. The next in importance is giving information on latest developments, literature on new equipment and advertising material for student use. This is encouraging as it shows the desire to use up-to-date and modern material. Third in importance is help desired in securing teaching aids, and fourth is the desire for suitable motion picture equipment.

At this time when reconversion is occupying the attention of so many individuals and when local and regional foundry groups throughout country are giving attention to the specific subject of closer cooperation with educational institutions, the facts set out in the study initiated by the Foundry Equipment Manufacturers Association present some extremely interesting information.

Table 5

FOUNDRY INSTRUCTION TEXTBOOKS USED

Foundry Work—Wendt	18
Metal Castings—H. L. Campbell	15
Mechanical Tools and Processes—Hesse	7
Manufacturing Processes—Begeman	5
CAST METALS HANDBOOK and other A.F.A. publications	5
Notes, mimeographed material, ICS pamphlets, faculty prepared instruction sheets	5
Foundry Practice—Palmer	3
Factory Equipment—Rose-Lytle	3
Engineering Materials and Processes—Clapp and Clark	3
Mechanical Processes—Begeman	1
Technical Production Processes—Connolly	1
Foundry Practice—Schubert	1
Foundry Work—Grennan	1
Chemistry of Engineering Materials—Wendt and Leighan	1
Units in Patternmaking and Foundry—Smith	1
Pattern Design—Hall-Kiley	1
Wood Patternmaking—McCaslin	1
MODERN CORE PRACTICE AND THEORY—Dietert	1

Table 6

OTHER AIDS USED IN INSTRUCTIONAL WORK

Motion pictures, slides	15
Charts, drawings, demonstrations, lectures, pictures	7
Visits to local foundries	6
Manufacturers' literature, library reference books, trade magazines, current magazines, literature	5
A.F.A. TRANSACTIONS and A.F.A. literature	3
ASTM *Standards*	1
X-ray and other laboratory control methods	1
Operate experimental light metals foundry	1
Sand and core testing equipment	1
Instruction Sheets for Foundry—Lewis and Dillon	1
Anything that can be carted into classroom	1

Table 7

ASSISTANCE BY LOCAL PLANTS

Aid in securing equipment; old and obsolete patterns for study	8
Arrange visits to foundries	7
Interest foundries in school programs in the trade; interest them in demanding college graduates fully trained; apprenticeship promotion.	6
Give closer cooperation and advice	3
Survey of need for foundry	1
Help in developing course of all engineering students in manufacturing processes	1

Table 8

SCHOOLS' SUGGESTIONS FOR AID

Help schools secure equipment, advise where available and when	19
Advise of latest developments; literature on new equipment; advertising that can be used by students	9
Help secure teaching aids	6
Make suitable motion pictures	4
Education advisors, teacher-supervisors, lecturers	3
Subsidize work in schools in donation of equipment and fellowships and funds for technical research	2
Contact people responsible for purchases	2
Establish cooperative program	1
Aid in setting up small school	1
Aid in equipping laboratory	1
Create interest in foundry work	1
Organize societies for students	1
Sponsor short courses with A.F.A. cooperation	1
Provide bibliography of literature on foundry practice	1
Sell graduates on field	1
Contact manufacturers of equipment.	1
Set up minimum requirements for course	1
Help set up testing laboratory	1
Send representative to see these people	1

SUMMARY OF PRESENT FOUNDRY FACILITIES AND FUTURE NEEDS OF EDUCATIONAL INSTITUTIONS

1. Interested in securing foundry equipment for apprentice training and trade extension.

2. Floor space available to teach sections of 15 to 20 men. However, proper equipment is needed, especially control instrument and a good representation of basic equipment.

3. Foundry consists of two small gas-

fired crucible furnaces, four small flasks, sand bins and working space. We wish to enlarge this to a complete small-scale foundry as soon as possible.

4. Cupola 20 in.; electric furnace 40-lb. capacity; metal pot furnace 16 in.; crucible furnace.

5. Postwar buildings will probably include some work in foundry.

6. One 250-lb., 3-phase Lectromelt; Tomaday 3-phase smelting furnace; 2-ton crane; casting floor and equipment; sand testing equipment; 1500-lb. steam hammer; heat treating equipment. All small commercial size equipment.

7. One 350-lb. Detroit electric furnace, one small gas-fired furnace, core oven, Simpson sand conditioner, molding benches.

8. One small melting furnace, oil fired, 1800° F., soft metal. Two molding benches, small supply of flasks and molder's tools.

9. Capacity for 600 students. Plans are underway for construction of new foundry in early postwar period.

10. Would like complete 2-ton unit.

11. Equipped with 24-in. cupola, crucible melting furnace and usual necessary equipment for molding, coremaking, cleaning; also for sand testing. Future needs are chiefly as listed under (3) plus new building or other space for foundry (and other metallurgical work) if present foundry building is used for other work.

12. One-ton cupola and one 500-lb. electric arc furnace. Feel a need to modernize.

13. Area, 4,000 sq. ft. Size of class, 20. Needed small induction furnace for steel; increase sand testing equipment; rotary table sand blast; molding machine; core oven, temperature controlled; sand blender.

14. Capacity 12 men per section. Have pot furnace for melting non-ferrous metals and small homemade cupola. Have no power or automatic foundry equipment.

15. Very small in connection with Department of Buildings and Grounds.

16. We have plans for such a laboratory and are working with A.F.A. and industry in trying to establish laboratory facilities.

17. Equipped with material testing machine, microscopes, hardness testers, sand testing equipment. Have facilities for sand molding, permanent mold, centrifugal casting, melting cast iron and non-ferrous metals.

18. Accommodate 12 students, anticipating more space for students and equipment. Casting cleaning equipment and other equipment.

19. Have a 1-ton and ½-ton cupola, three gas-fired brass or aluminum furnaces, two core ovens, one tumbler, one sandblast, one muller, numerous flasks of various sizes, one jolt-squeeze machine, nine steel molders' benches, ½-ton overhead electric hoist.

20. Have three gas-fired crucible furnaces melting non-ferrous metal only. Accommodating 16 students. Would like to install electric furnaces and melt iron and steel in addition.

21. Very inadequate. Would like to have a small cupola with controls, small sand mixer, small molding machine, small core oven and some casting cleaning equipment and a small crane.

22. Eighteen students, capacity of laboratory at one time. General foundry laboratory and foundry control laboratory includes x-ray equipment. The general laboratory contains 1-ton cupola, one electric furnace, one gas-fired crucible furnace, molding machine, casting cleaning equipment, portable oven, and other miscellaneous foundry machines and equipment. The control laboratory includes a full line of equipment for sand analysis, chemical control equipment and x-ray apparatus.

23. Foundry building 36x75 ft. with 2-ton cupola. Need electric furnace for steel melting, and molding and testing equipment.

24. We use our foundry as a laboratory as well as for foundry practice.

25. Comprises facilities for classes of 24 students at one time; 8,000 sq. ft.; 32-in. cupola, Detroit electric furnace and crucible furnace; sand machines, sand mixers, core ovens, cleaning equipment, much of which is 20 years old and needs replacement and modernization.

26. One-ton traveling crane, 22-in. cupola, 1,200 sq. ft. molding floor for iron, 450 sq. ft. molding floor for aluminum and brass.

27. Student capacity, 10 to 12 at one time, depending upon available floor space for molding. Added capacity obtained by using foundry often.

28. We are definitely interested in developing a program in foundry practice for the postwar period.

29. Have laboratory for course in "Founding and Patternmaking" with capacity for 20 students. Will need to replace equipment soon.

30. Laboratory 50x104 ft., capacity 50 students. Equipment includes bench molding equipment and aluminum flasks, molding machines, drawer-type core oven, pit furnace, cupola, small arc melting furnace, tumbling mill, sandblast. Future needs include rearrangement of equipment and space, new melting equipment, new molding machines, sand testing equipment, equipment to demonstrate sand handling, sand conditioning, and sand control.

31. Equipment includes one Whiting cupola, 22 in.; two crucible furnaces; one core oven; one molding machine, sand testing laboratory, pattern and flask equipment for class of approximately 25. Need additional molding machines, flasks, induction melting furnaces, new core oven, and additional cleaning equipment.

32. A capacity of 24 students per section when additional equipment is added.

33. Have 20-in. Whiting cupola, Campbell-Hausfeld crucible furnace and gas-fired aluminum furnace, molding floor 36x48 ft.

34. Have No. 1 Whiting cupola, 100-lb. crucible oil-fired furnace.

35. Capacity now eight students for several weeks each on a rotating basis. This will do us for the next 5 years.

36. Small cupola, flasks, core oven, etc., available.

37. Foundry laboratory includes 2-ton capacity cupola, ladles, flasks, one gas melting furnace of small capacity, a core oven, and pattern shop.

38. We have small gas furnace, some patterns and flasks, a core oven and core molds.

39. Our present equipment limits us to brass and aluminum.

40. Might be interested in adding capacity for magnesium alloy work.

41. We need to start from scratch and build a complete laboratory foundry.

42. Have bench molding facilities for 12 students, portable squeezer, gas-fired furnace for No. 40 crucible, core bench, core machine, core oven.

43. Have space but no equipment.

44. Very small but we are able to teach the fundamentals.

45. Have a small crucible for aluminum and brass for use in our metal shop.

46. Planning to offer work in metallurgy, particularly of iron and steel, as soon as possible.

47. Laboratory is 30x60 ft. with an L 30x30 ft. A 20-ft. traveling crane runs along the one side of the laboratory (60 ft.). Equipment is as follows: One squeezer type molding machine; one turnover type molding machine, small; one jolt type molding machine, 18x24-in. bed; one stripping plate type molding machine, small; one gas-fired crucible furnace for aluminum, 20 lb.; one crucible furnace for brass, capacity 100 lb.; one cupola, 32 in. inside diameter; one sand testing laboratory; one tumbling barrel; one muller type sand mixer.

48. We have a 21-in. Whiting cupola, a natural-gas-fired furnace handling 75-lb. crucibles for melting brass and aluminum. Need more steel flasks, a muller and sand testing equipment.

49. We do a few experiments in making simple molds and pouring with lead.

50. Have no suitable space for foundry. Might be able to arrange space for melting non-ferrous metals.

51. Have a tilting crucible and can pour non-ferrous metals and alloys. Have a very large iron cupola, entirely too large for economical use. Need a small iron foundry.

52. Molding (hand or bench) for six, but need 12. Have steel shot blast rattler for cleaning, electric riddle, 90-lb. gas-fired crucible furnace. Need larger capacity.

53. One is being planned at present for postwar use.

54. Foundry floor space is 2880 sq. ft.; sand testing laboratory, 780 sq. ft.; coreroom and storage, 2880 sq. ft. Have 22-in. cupola, 3 molding machines. Need electric furnace, sand mixer, some sand testing equipment, core oven.

55. Are equipped to instruct about 20 students at one time. They receive instruction in molding, coremaking, melting (cupola, electric arc and crucible) and cleaning operations. Also sand and metal testing procedures.

56. Have 18 work stations, a 26-in. cupola, and non-ferrous melting furnaces.

57. We have a one-ton cupola, but need more modern equipment.

58. Have a cupola and four small furnaces, a floor capacity to take care of 25 students at one time, 200 students per quarter.

59. Small muffle furnace, gas-fired, suitable for melting brass and aluminum.

60. Have a small furnace and other necessary equipment for elementary foundry work.

61. Have not believed that under the conditions here, where we are located in a great foundry center, a laboratory foundry is necessary. Our men do have connections with and may work out problems of metallurgy and practice at local plants.

62. We cover various molding oper-

ations. Do not use cupola. Expect to build new laboratory in near future.

63. Are planning a larger unit. Will build separate foundry building in near future.

64. We plan to equip a complete small foundry with an electric arc furnace if possible.

65. Have 1¼-ton cupola, 18-in. design, and one Campbell-Hausfeld brass melting furnace.

66. In changing buildings our original foundry equipment was dismantled, some disposed of and some retained.

67. Have one No. 30 cupola; one core oven and car; one brass furnace, as well as ladles, flasks, hand tools, grinder, and tumbler.

68. Have a small Whiting cupola, 60-lb. electric furnace and 60-lb. non-ferrous furnace. Floor space, 30x60 ft. Homemade benches.

69. We hope to expand and are thinking of metallurgical and foundry laboratories for the future.

70. Operate small brass foundry.

71. Have Whiting cupola No. 1.

72. We installed an electric furnace and foundry in cooperation with NYA, but when it disbanded, all equipment was disposed of, so now starting anew.

73. Have equipment for melting cast iron and non-ferrous metals. Molding equipment is also available and testing equipment for testing castings and cores.

74. Furnace equipment consists of 14-in. cupolette. Iler brass furnace and 10-lb. Detroit electric furnace. Do not have sandblast equipment. Have a permeability tester, but no other sand testing and handling equipment. Have small assortment of flasks and one mechanical squeezer.

75. Have little or no molding equipment, no facilities for coremaking, no sand and other standard foundry testing apparatus. Willing to open up new room to be devoted exclusively to that kind of work. Feel that we are well equipped in accessory equipment necessary for founding work. For example, we have all of the regular hardness testing equipment, including Brinell, Rockwell, scleroscope hardness testers; extensive metallographic equipment, including a Bausch-Lomb research metalloscope, an x-ray defraction unit, a Baird 30,000 line grating spectograph, an induction melting furnace, an arc furnace, and other miscellaneous melting equipment; adequate control equipment, including five automatic temperature controlling devices and two Leeds & Northrup micromax six-point recorders.

APPRENTICE CONTEST

Interest Grows as Convention Nears

THE NATIONAL APPRENTICE contest, sponsored annually by the American Foundrymen's Association, continues to attract attention. Numerous requests have been received by the National Office for blueprints for the Patternmaking Contest, and for patterns to be used in the Molding Contest. Increased interest in the contest is believed to be due to widespread recognition by management that participation stimulates apprentices to superior craftsmanship.

Although the contest is open to all apprentices whether affiliated with an A.F.A. member plant or not, apprentices must be indentured to be eligible for competition. An apprentice may enter any of the four divisions in competition for the prizes of $30, $20, and $10 which are offered in Patternmaking, Gray Iron Molding, Steel Molding, and Non-ferrous Molding. The 12 national prize winners also receive certificates in recognition of their achievement.

Awards at Convention

For the first time in the history of the National Apprentice Contest the first prize winner in each of the four divisions will be brought to the 50th Annual Convention to receive his award.

An apprentice can be entered in the contest by his foreman or supervisor. He can compete in more than one division of the contest if he chooses. For instance, he may wish to enter the gray iron molding and the non-ferrous molding divisions of the contest.

Planning the Work

Contestants do not see the pattern for the molding contest nor the blueprint for the pattern contest until it is handed to them by the local judges. Starting with the usual standard equipment, the apprentice plans and executes his work. Grading by the judges follows a prescribed form and for the molding contest is based on general appearance, soundness, gating and risers, chills and nails, and time. In the pattern division judging is based on accuracy according to blueprint, moldability, workmanship, and time.

Contest regulations and judging forms may be obtained from the American Foundrymen's Association, 222 West Adams St., Chicago 6. Because of the limited number of patterns available, use must be requested in advance so that they may be routed to reach all contestants.

Arrange Exchange Paper Idea With Australians

WORD HAS BEEN RECEIVED from W. T. Main, Honorary Secretary, Institute of Australian Foundrymen, that the Institute has accepted an A.F.A. invitation to start a series of exchange papers similar to the series which has been in force between the A.F.A. and the Institute of British Foundrymen. The first of the exchange papers with Australia will be written by L. B. Knight, Lester B. Knight & Associates, Chicago. Mr. Knight, as an A.F.A. member, will prepare a paper devoted to possibilities for the efficient mechanization of moderate-sized foundries.

The exchange paper from Australia, which will be presented before the A.F.A. 50th Anniversary Convention in Cleveland, May 6-10, will be written by H. E. Arblaster, B.Met.E., a member of the Victorian division of the I.A.F. This paper will deal with magnesium bronze and will discuss the standards of manufacturing these metals in Australia.

LeThomas Will Present French Exchange Paper

FROM P. BASTIEN, President, Association Technique de Foundrie (French Foundry Technical Association), word has been received that an official exchange paper will be presented on behalf of that Association before the 50th Annual Convention. This paper will be prepared by A. LeThomas, Vice-President and Director General, Technical Center of Foundry Industry.

This will be the first French foundry paper presented before the A.F.A. since 1938. A.F.A. members may recall that Mr. LeThomas presented a paper before the International Congress held in Detroit in 1926.

Screen Equipment

Screen Equipment Co., Inc., 9 Lafayette Ave., Buffalo, N. Y., is distributing their booklet on "Guide to Better Screening." A variety of vibrating screens is illustrated.

REPORT OF THE A. F. A. COMMITTEE ON

ALUMINUM

CASTING STABILITY

Dimensional changes in aluminum alloy castings... caused by density changes . . . residual stresses resulting from plastic deformation . . . selection of conditions and treatments to attain stability.

Aluminum and
Magnesium Division

REPORTS from various sources indicate that difficulty is sometimes encountered with aluminum castings that are machined after heat treatment. The parts after machining are found to have changed dimensions. Since this problem is of particular importance to some producers, a subcommittee was appointed to investigate the problem and to submit suggestions.

This committee has contacted persons familiar with the problem and the information submitted by them has been of great help in preparing this report. Much of the information may be familiar to those who have been interested in this problem previously, but it is given in this report for the benefit of those who are not so familiar with the problem. The information is given as closely as possible in the wording and manner in which it was submitted.

The committee wishes to extend its sincere appreciation to those who were kind enough to submit the suggestions and data reported.

Committee Report

C. C. Hitchcock (R. C. Hitchcock and Sons, Minneapolis) submitted the following information:

"The problems we are experiencing in dimensional stability probably can be attributed mainly to internal stresses set up by quenching heat-treated alloys. We know that some instability is caused by work hardening of the surface when tools get slightly dull.

"We have been carrying on many experiments with different annealing temperatures after the quenching operation and find that this helps to relieve our problem."

A brief outline of the deep-freezing process often used to overcome the difficulty was given by Mr. Hitchcock as follows:

"The deep-freezing process consists merely of taking the casting down to below 100° F. below zero and then raising the temperature to 200° F. and repeating the process five and six times. The only advantage that I can see to this is molecular movement due to the change of temperature which tends to put at rest any casting strains."

The committee presented two other questions to Mr. Hitchcock: (1) Over what temperature range are the castings expected to have dimensional stability? (2) Since much of the dimensional instability is attributed to internal stresses set up by quench heat treatment, what results have been obtained with non-heat-treated alloys?

Mr. Hitchcock replied as follows:

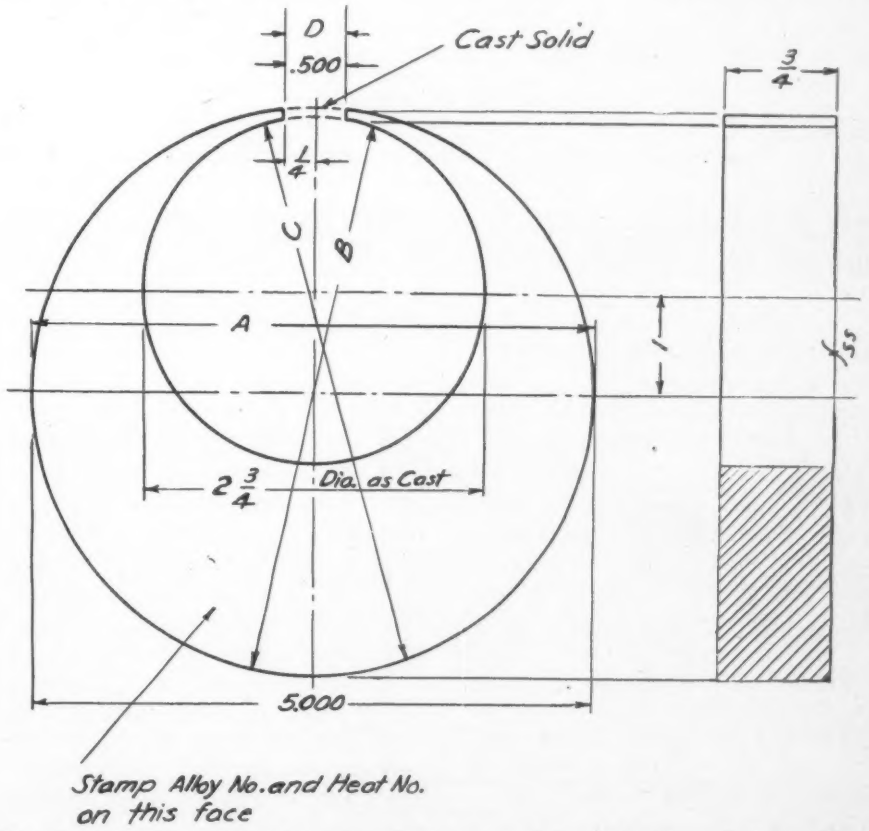


Fig. 1—Sketch of distortion test specimen used for detection of dimensional changes.

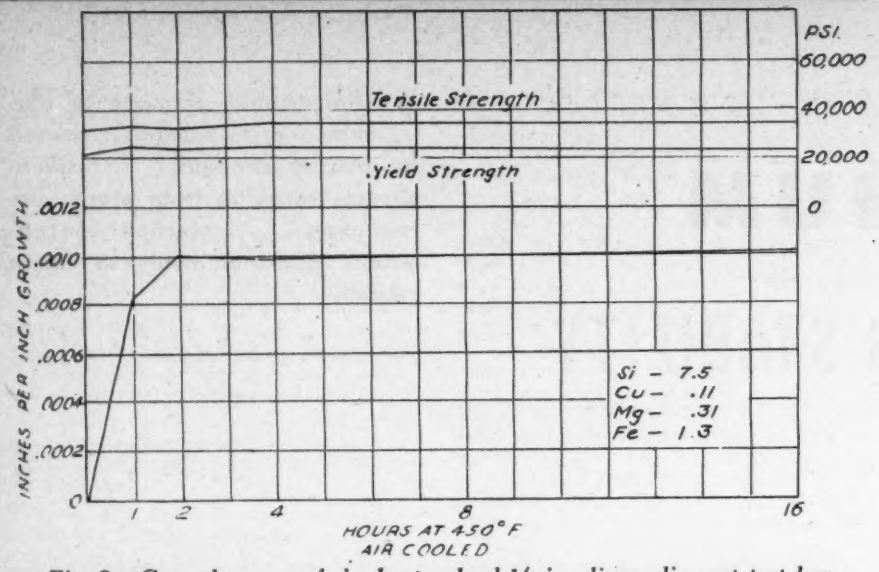


Fig. 2—Growth curve of single standard ¼-in. diam. die cast test bar.

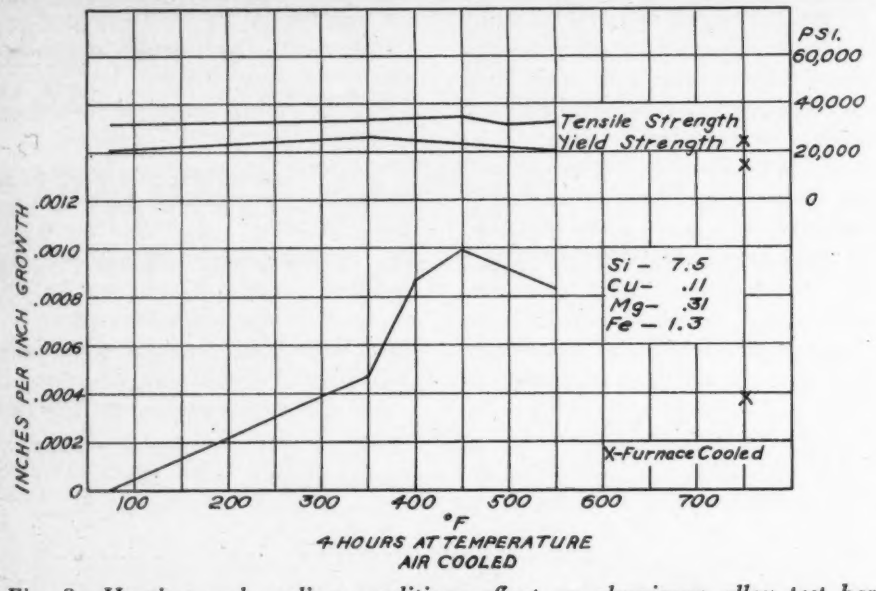


Fig. 3—Heating and cooling conditions effect on aluminum alloy test bar growth.

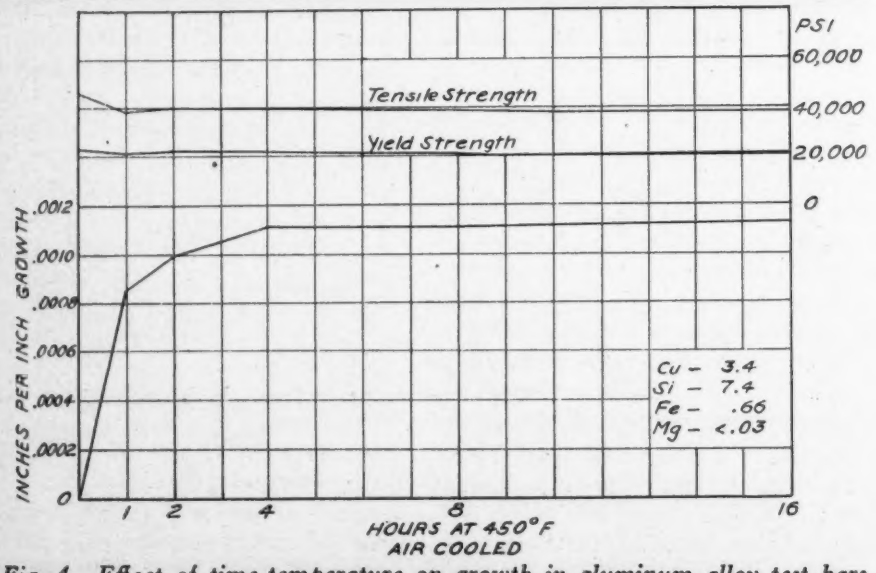


Fig. 4—Effect of time-temperature on growth in aluminum alloy test bars.

"The temperature range in which we must maintain stability in our castings is from 212° F. to 40° F. below zero.

"We have not done a great deal of experimenting with non-heat-treated, high strength alloys, but our experience with commercial grade as-cast alloys such as 108, 212 and the like, has not been satisfactory. This we attribute to the fact that unless the casting sections are absolutely uniform, strains are set up in the casting processes which will relieve themselves over a long period of time. We have, therefore, gone to heat-treated alloys, feeling that the stresses and strains resulting would be far less detrimental than those incurred in the casting process. This is more true in castings where there is considerable core.

"Our trouble does not lie 100 per cent in instability after the article is in the field. A great deal of it occurs during the fabrication or machining. In some instances we have found that the machining and jigging of the castings were at fault, but we are not satisfied that the ultimate in casting stability has been reached."

Heating and Cooling

Wayne Martin (then with Sperry Gyroscope Co., Flushing, N. Y.) submitted the following information:

"We use 5 hr. at 450° F. heat treatment followed by air cooling at the expense of the resultant mechanical properties. In no case over a period of years has this treatment failed to produce the best of stability, and it has been used on dimensionally unstable castings of 195 and 356 alloys in the T6 condition and made them stable.

"In many cases it is conceivable that in some instances such a treatment would be undesirable because impact properties and other properties often deteriorate with such treatment. In the case of some thermostats we have, on advice of Louis Kempf (Aluminum Co. of America, Cleveland), gone to one hour at 750° F., which annealed the casting soft, but the stability was certainly there.

"On die castings we use 16 hr. at 450° F. and appear to have dimensional stability. Apparently silicon-aluminum die castings present the greatest problem relative to stability. Temperatures higher than 450° F. we feel should not be used on thin-

wall die castings because the yield strength drops off fast.

"We feel that dimensional stability of aluminum castings is associated with three factors. They are as follows:

"(1) *Growth in silicon alloys.* A casting hardened at 320° F. will grow in volume considerably if heated to temperatures approaching 500° F. This has been checked several times. We presume that surface heat generated in machining sometimes causes localized growth with resulting dimensional change.

"(2) *Volume changes due to precipitation hardening.* We have always assumed that this could cause volume change and thus dimensional unstability. We have never traced any of our trouble to this cause for we have never machined castings until after they have been fully precipitated by heat treatment.

"(3) *Locked-up stresses from casting, quenching, or straightening.* We have definitely found cases where 356 and 195 alloys have been unstable due to quenching in water at too low a temperature. The 320° F. heat treatment was not sufficient to stress relieve the castings in this case, but the 450° F. treatment for 5 hr. did work. We feel that most of the trouble with dimensional unstability results from quenching stresses or subsequent straightening stresses set up in straightening castings that have warped out of shape during the solution heat treatment.

"We are, at the present time, working on improvements of a high-zinc alloy which can definitely be stabilized by heat treatments in the range of 400-700° F. and still show mechanical properties in the neighborhood of 25,000 psi. yield strength and 40,000 psi. ultimate strength with 4 per cent elongation."

Instability Causes

In order to clearly establish the type of instability and the relative amount of it, the committee asked Mr. Martin to answer two questions: (1) How do you test for stability? (2) Is the instability to which you refer due to the natural coefficient of expansion or is it in excess of the normal change due to the coefficient of expansion? Mr. Martin's answer was as follows:

"We do not know of any good means to check dimensional stability from all possible causes, except by use of intricate castings. The instability to which we refer is not temperature coefficient of expansion, but a permanent change in dimensions at constant temperature. We have had 356T6 castings move as much as 0.005 in. in 20 in., but in many of our parts we are interested in holding tolerance stable to as close as ±0.0001 in.

Locked-up Stresses

"Most of the instability shows itself after rough machining, which makes it appear, at least in our case, as if it were a matter of locked-up stresses. Assuming the worst possible case of this type, we would have an aluminum alloy with an elastic limit of approximately 10,000 psi. Assuming that a very drastic quench was applied, causing a locked-up stress in excess of the elastic limit, the casting would be subject to plastic deformation to the extent of the stress in excess of the elastic limit, leaving a locked-up stress of 10,000 psi.

"Then again, assuming the worst possible case, that is, a machining operation which would cut away enough metal to permit the complete removal of the 10,000 psi. locked-up stress in the outer fibres, based upon a 10,300,000 modulus, the strain resulting from the 10,000 psi. stress would be 0.001 in. per in. If this extreme case had been applied to our casting over 20 in., the movement could have been 0.020 in.

"Since this casting had been aged at 320° F., the locked-up stress could not have been 10,000 psi., because the elastic limit at that temperature is considerably lower and the stress would have been relieved by that percentage. It would appear that the 0.005-in. movement could fall very well within the probable expectation of what would happen, as a result of a quenching stress equal to the elastic limit.

"As to measurement of this type of instability, a very good paper was presented recently by A. E. McPherson, of the National Bureau of Standards, Washington, D. C., before the May 20 meeting of the Society for Experimental Stress Analysis, in Boston. By use of SR4 gages and very careful cutting of a magnesium casting, he was able to find a locked-up stress of 4,000 psi. in a casting subject to failure at that point.

"The same technique could be used to determine dimensional instability as the result of locked-up stresses, but probably could not be used to determine volume changes due to precipitation hardening, or changes due to growth at elevated temperatures, because of the instability of the SR4 gages, over a period of time."

Sperry Gyroscope Co. has reported the use of the distortion test specimen shown in Fig. 1, which is similar to that used for tool steels:

"The specimen is cast and the dimensions *A, B,* and *C* are measured immediately after casting. At the time at which a distortion test is desired a cutter of ½-in. width is used to slot through the thin portion of the casting. If there is any distortion after cutting, this is detected by noting the change in dimensions *A, B,* and *C,* and also by taking a fourth measurement *D* which indicates how much the ½-in. gap has increased."

This test was used on an Al-Zn-Mg alloy (40E) and indicated no distortion after either 4 weeks aging at room temperature or after heating to 360° F. to accelerate aging. (This alloy requires no solution or quench heat treatment.)

Distortion Tests

Mr. Martin later added the following comment:

"This tool steel type of specimen was used on several solution heat-treated alloys and showed them to be stable. Later castings of the same alloy gave trouble from dimensional unstability in manufacturing. The errors in measuring this specimen are probably greater than the tolerances required on many castings. I do not believe that this test is of much value as shown here."

In reviewing Mr. Martin's report, Mr. Jung (Sperry Gyroscope Co.) extended the following information:

"Curves (Figs. 2, 3, and 4) which were plotted from results obtained from single standard ¼-in. diameter die casting test bars may be of interest. All growth is attributed to precipitation. No signs of locked-up stresses which could account for any appreciable amount of the growth were found. As a result of these tests, we are now heating our die castings for 5 hr. at 450° F. for dimensional stability.

"Similar dimensional tests on sand-cast 40E and ternalloy 6 indicate that dimensional changes from aging

will be considerably less than 0.002 in. per in.

"Tests made on alloy 356 sand-cast distortion specimens which were described by Mr. Martin have indicated the following:

"(*a*) Growth from aging will reach a maximum of approximately 0.001 in. per in. at 450° F. after casting. Little if any locked-up stresses which may cause distortion will be present.

"(*b*) Aging of this alloy after solution heat treatment will not cause any appreciable growth. However, considerable locked-up stresses, which will not be relieved after heating at 310° F., may be present. This can cause considerable distortion when the castings are machined. The heat treatment needed to remove these stresses has not been determined as yet. At the present time we are using 5 hr. at 450° F. and accepting lower mechanical properties if stability is required."

R. E. Ward (Eclipse Pioneer Div., Bendix Aviation Corp., Bendix, N. J.) submitted the following information:

"The first tests that we conducted on stability of castings that I remember were on sample castings which were made up of non-heat-treated alloy (8 Zn, 0.90 Mg, 0.50 Cr, and 0.15 Ti). The tests were comparatively simple but produced results which were satisfactory. We poured an intermediate housing casting which is a cylindrical part of about ¼-in. wall thickness having a diameter at one end of about 7 in., a diameter at the other end of about 4 in., and neck down in the center to about 3-in. diameter. We cast the part, machined the end diameters, performed the desired heat treatment (aging) and then cut the part longitudinally and measured any distortion of the diameters.

Tolerances Maintained

"The problem of light alloy casting stability has been one we have had to face constantly since many of our castings are machined as close as +0.003 in. and −0.0 in. and, as is well realized, complete stability is necessary to maintain these tolerances. We have found that a stress relief anneal at 375° F. for 2 hr. performed between the rough and finish machining operations gives us the desired stability, provided the finish machining operations are done with sharp tools and the castings are jigged in the machines without distortion.

"When such extremely close dimensions as those mentioned must be held, we find it advantageous to do the finish machining after the paint and baking operation since a paint bake of one hr. at 300° F. might cause distortion. Whether or not it does cause distortion has never been definitely decided to the satisfaction of everyone since whenever tests are conducted we have found no distortion, but when close machining is done after baking in production it is reported that the castings sometimes change dimensions.

"It is believed that any thin-wall casting of fairly large dimensions is a satisfactory one for conducting distortion tests, but it must be borne in mind when conducting these tests that the differential coefficient of expansion of steel measuring instruments on aluminum or magnesium is so great that a few degrees change in room temperature will affect the tests to the point where they may be worthless."

Temperature Ranges

The committee requested Mr. Ward to answer three more questions: (1) Within what temperature ranges is it usually desirable to expect casting stability? (2) If most of the distortion is due to locked-up stresses caused by heat treating, is it possible that high strength non-heat-treated alloys artificially aged at 356° F. may help to overcome the problem? (3) Where castings are annealed at say 375° F. before machining, what is expected in the way of strength properties?

Mr. Ward's answers to these questions were as follows:

"In manufacturing aircraft accessories, it is desirable to expect casting stability within the temperature range of −75° F. and +350° F. This is to take care of cold weather operations and operation at about the temperature of the engine oil. Naturally, not all castings are subject to as high a temperature as 350° F., but in the case of pumps temperatures of even 400-425° F. are not unusual.

"It was mentioned that several companies expressed the opinion that most of the distortion is due to locked-up stresses caused by heat treating. This may be true in solution-treated castings but, as stated in a previous letter, we have never experienced distortion of solution treated and aged castings stress relief annealed between the rough and finish machining operation, even when holding extremely close tolerances.

"When castings are stress relief annealed at 375° F. before final machining, we do not experience any appreciable drop in physical properties. As a matter of fact, we still age 195 aluminum alloy in the foundry at 375° F. and follow up with a stress relief anneal when necessary.

"Sometime ago we considered eliminating the aging after solution treatment in the foundry and using the stress relief anneal between finishing and final machining as the aging treatment so as not to overage the castings. This has worked satisfactorily, but we have not as yet changed all parts since it requires a considerable number of drawing changes and since we are at present meeting the desired physical properties.

"For a number of years we have been keenly interested in the high strength, non-heat-treated alloys which are artificially aged for 10 hr. at 356° F., but we have felt that certain drawbacks such as castability and the necessity for close control of impurities and balancing of alloying elements have made this type of alloy less desirable than the presently used high temperature solution-treated alloys."

Support During Machining

Dr. David Basch (then with General Electric Co., Schenectady, N.Y.) submitted the following:

Lack of support during machining was found to be a great cause of warpage during machining. Tool pressure deforms low yield strength alloys unless the parts are properly supported.

On non-heat-treated alloys a stabilizing treatment of 6 hr. at 275° C. (527° F.) is used. Alloy 43 is held 3 hr. at 600° F. This treatment is not used on heat-treated alloys due to the consequent lowering of physical properties.

Alloy 40E was stable after machining following a 10-hr. age at 356° F. Higher aging temperature destroys physical properties.

Alloys 355 and 356 are held at 440° F. for 8 hr. for stress relief,

but yield and tensile strength are considerably reduced.

Because of the possibility of cracking castings in straightening operation following quench heat treatment and age (T6), General Electric Co. asks that all parts be preheated in boiling water before straightening.

Grogan and Clayton[1] investigated the dimensional stability of heat treated aluminum alloys and arrived at the following conclusions:

1. Changes in dimension occurring after heat treatment were much larger in wrought "Y" alloys and duralumin than in those of the cast series.

2. Considerable dimensional changes occur when material quenched in cold water is machined. Changes were greatest in "Y" alloy, less in duralumin, and 25S alloy, and still less in the copper-silicon alloys.

3. In "Y" alloy and duralumin quenching in cold air reduces the dimensional changes which occur on machining as compared with cold water. Quenching in boiling water reduces them to relatively small proportions.

4. These dimensional changes do not appear in annealed material.

Effect of Aging

Frontier Bronze Corp., Niagara Falls, N. Y., reported a test which was made by one of its customers on a large 40E casting. Due to government restrictions covering the article tested the complete story cannot be given, but a summary is presented herewith.

A large reflector casting of 40-in. diameter and dished like a searchlight reflector was cast and artificially aged 10 hr. at 356° F. Prior to machining, the casting was fastened on a machining jig and set screws placed at various parts of the casting. The casting was then machined over the entire reflector surface, which gives a rough idea of the amount of metal removed.

After the machining was complete dimensions were checked at each of the set screws. A 0.001-in. gage was used for this check, and at no place was the change in dimension large enough to permit passage of the gage. It was roughly estimated that any dimensional changes were in the neighborhood of 0.001 inch.

Since there may be some interested persons who are not familiar with the "deep-freeze" process of relieving stresses, a brief review is given herewith of the process as described by G. F. Forsthoefel[2]:

Down to —50° F. is used to stabilize metal in precision gages or instruments. Sub-zero temperature is applied 4 to 6 hr. The part is then raised to room temperature and then again subjected to sub-zero for 4 to 6 hr. This process may be repeated four to six times. Some gage manufacturers add a heating cycle after the sub-zero period by inserting the part in boiling water after each cooling period.

The process is said to result in alternate expansion and compression of molecules whereby after repeated cycles the metal finds a stabilized molecular condition. By stabilization it is not meant that the metal will not expand or contract with temperature changes, but it does mean that all internal strains have been relieved so that when the gage is subjected to repeated temperature changes it will always come back to the exact size it had at the time it was finished at a given temperature.

Summary

Howard Rowe, committee member, made the following summary of the data:

"There are two causes, and only two, of lack of dimensional stability of aluminum castings. There are (1) density changes involved in changes of concentration of constitutents in the aluminum solid solution, and (2) residual stresses resulting from plastic deformation. Evidence of dimensional instability from either of these two causes may be the result of the algebraic sum of both efforts acting independently.

"In general, the condition of a saturated solid solution in most commercial aluminum alloys is the condition of maximum density. Precipitation of constituents from a solid solution is, therefore, accompanied by a decrease in density or permanent growth. Maximum mechanical properties usually are attained at a density lying somewhere between the maximum of the solid solution and the minimum of the completely annealed structure.

"Various compromises can be struck between maximum mechanical properties and complete stability by the selection of proper conditions of the precipitation or aging treatment. Generally speaking, the higher the temperature and the longer the time of the precipitation treatment, the nearer the structure comes to complete dimensional stability.

"The plastic deformation resulting in residual stresses, which may cause distortion on removing a part of the structure by machining or otherwise, may arise during quenching from a high temperature solution treatment or from straightening of the casting at temperatures below the annealing range. Welding, which may involve rapid cooling from elevated temperatures, also may produce plastic deformation resulting in residual stresses. Similarly, the restrained cooling of a casting in a mold may give rise to plastic deformation which will result in residual stresses.

"Residual stresses may be relieved by heating the casting to temperatures up to about 750° F. followed by slow cooling to room temperature. Such a treatment will reduce the residual stresses to substantially zero with, of course, a sacrifice in the mechanical properties obtainable. Here again a compromise may be achieved by heating at temperatures below the annealing range. The higher the temperature and the longer the period of time, the greater the reduction in residual stress."

Personnel of the Committee on Casting Stability, Aluminum and Magnesium Division, is as follows: H. Brown, *Chairman,* G. H. Starmann, H. J. Rowe, and R. E. Ward.

Specifications Committee Renamed for New Program

Gray Iron Division Specifications Study Committee met in the office of the Association on January 17. This meeting completed the preliminary discussion of the group on ways and means of attacking the problem, and it was finally decided that the name of the committee should be changed to Committee on Section Size - Mechanical Property Relationships.

[1] J. D. Grogan and D. Clayton, "Dimensional Stability of Heat-Treated Aluminum Alloys," *Journal,* Institute of Metals, vol. 45, p. 157 (1931).

[2] C. F. Forsthoefel, "Sub-Zero Temperatures in Industry," *Refrigeration Engineering,* vol. 46, no. 3, Sept., 1943, pp. 164-7.

INSPECTION

STEEL CASTINGS

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START OF INSPECTION, as is well known, was due to the fact that supervisors in charge of the progression of work had little time for quality. As a result, help was needed for inspection of the work to insure proper quality. The addition of inspection greatly relieved the supervisor in charge of production, enabling him to study ways and means of increasing production throughout the department.

Inspection work in its infancy was taken with a feeling of resentment and was considered a "necessary evil." An inspector's job in the early days was no bed of roses; he was between two fires at all times, namely, the antagonistic attitude of the worker who believed he was being hindered in his work, and resentment by supervisors who felt that the inspector, in trying to produce a quality casting, was responsible for hindering production. Thus, when the sequence of operations did not function freely, the inspector sometimes was blamed for this delay in production.

As the years went on, the supervisor was convinced that inspection was here to stay. He realized that it was necessary to have inspection, not only to insure the proper quality of production, but also to aid in the sequence of operations. As a result of inspection, top management's attention was drawn to the fact that complaints of the customers were reduced greatly due to the improved quality of castings shipped, and naturally this improved quality increased sales. Thus inspection was set up in industry as routine function of production and not, as previously considered, a "necessary evil."

As inspection progressed, it was found that inspection solely on the finished product was not sufficient and it was essential that inspection extend into actual production. This type of inspection was termed process inspection. Today we are placing more and more emphasis upon inspection of core and molding procedures. This inspection insures use of proper sand and proper solidifyplacing of vents. It also insures proper fit of cores in the mold, and thus helps to insure proper dimensions of finished castings.

Customer Trained Inspectors

The customer early came to realize that he needed some way to insure the quality he desired, so he began training inspectors of his own and sending them into the producers' plants to make certain he was getting the quality he desired.

It is always best to accept outside inspection openly, remembering that if the local plant inspection forces are properly trained and the product is up to customer's standards, additional inspection from an outsider ing methods, correct ramming and helps to increase confidence in the product.

In the past, the author believes, outside inspection was looked upon with a certain amount of resentment by some of the producers. However, present-day management welcomes inspection from the customers. It helps to keep the plant organization alive, and on their toes, but, regardless of outside inspection, all products shipped should be up to standard quality.

Inspection in industry at this time is well organized or should be, working closely with the designing engineer's department as to welding limits, defects, tolerances, and customer's requirements or specifications. This cooperation is necessary since it helps the production department in a number of ways, such as changing intricate designs that cause trouble in the production of quality castings.

The inspection department also should keep production departments advised at all times, and as soon as possible, as to points of inherent defects, so that prompt corrective measures may be taken to insure a low defect rate. The pattern department should be notified as to faulty dimensions in order to correct these errors at once.

A review of the product in process, to eliminate defective castings as soon in the sequence of operations as possible, is essential to prevent high production costs. Repairing of minor defects should be controlled by well-trained shop inspectors, but all defects of major size need the judgment of a supervisor with training of both practical and technical nature.

First, he should understand the direct use of the castings in question; second, to know high stress points and intermediate stress points, along with a well balanced practical knowl-

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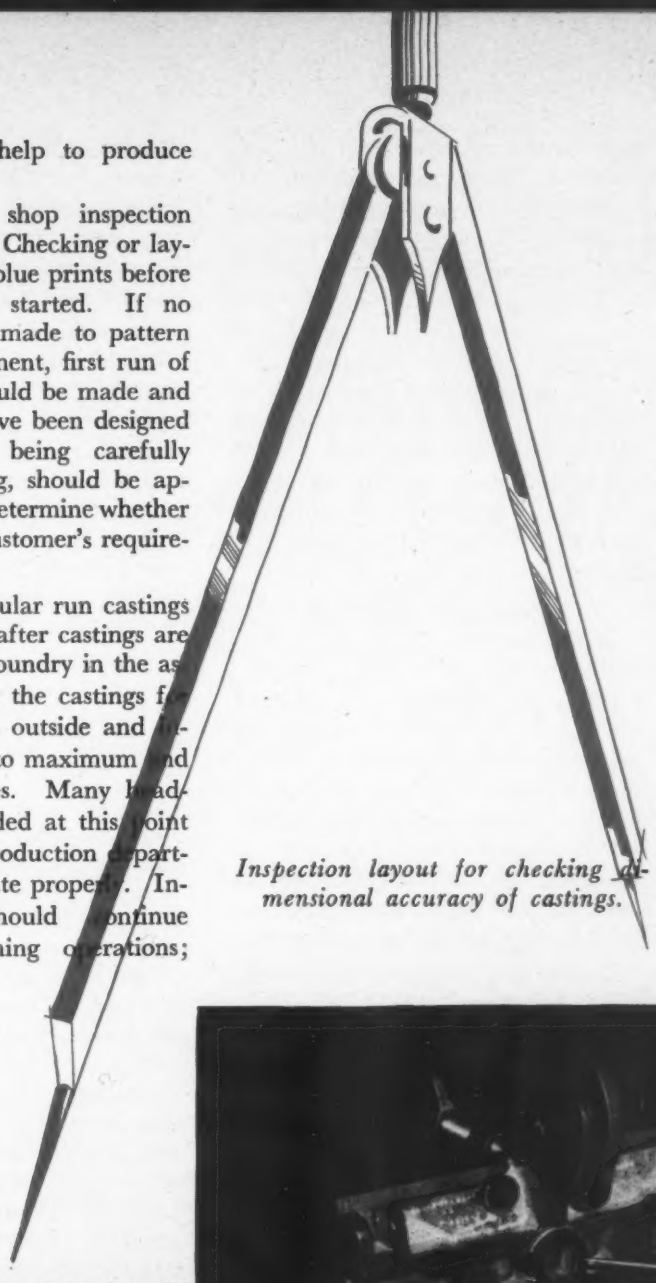
edge, which will help to produce quality castings.

A sequence of shop inspection may be as follows: Checking or laying out castings to blue prints before full production is started. If no changes are to be made to pattern or core box equipment, first run of several castings should be made and all gages, which have been designed for casting after being carefully checked to drawing, should be applied to casting to determine whether casting will meet customer's requirements.

Inspection of regular run castings should then begin, after castings are received from the foundry in the as cast state, checking the castings for defects and various outside and inside dimensions as to maximum and minimum tolerances. Many headaches may be avoided at this point if inspection and production department heads cooperate properly. Inspection then should continue through the finishing operations; gages and templates which were used on first run castings should be applied and properly fitted.

The finish of the castings also should be considered. Additional inspection then should be given castings by final inspectors, and all points of castings should be rechecked for defects. The work of inspection should be done so thoroughly that, whether or not customer's inspection is required, a quality casting is shipped at all times. However, if customer's inspection is not required, an additional company inspection should be made by the inspection department supervisor or his appointed representative for a final check before shipping.

It is the author's opinion that a well organized inspection unit should be formed, consisting of three parts. First, a well organized process inspection department should function in the coreroom and foundry, working in accord with the heads of both departments, with full power to suggest and help correct all faulty



Inspection layout for checking dimensional accuracy of castings.

(Courtesy Caterpillar Tractor Co.)

Adoption of many new technical tools has brought about remarkable advances in foundry practices and improvements in products. From cooperation with designing engineers to judging the quality and serviceability of the finished casting, well-organized inspection units have helped the foundryman to make better castings at lower cost.

conditions existing in these departments pertaining to quality castings.

Second, a technical unit for x-ray and magnetic particle inspection of all samples and experimental castings to insure sound castings. Internal defects can be pointed out to the foundry and corrected at once.

Third, a practical unit consisting of well trained sample checkers and inspectors adapted to all inspection problems. These men should be capable of passing judgment as to what is a good quality and serviceable casting, in compliance with the plant and customer standards.

It also is necessary to plan all production. A committee should be formed of the supervisors of all departments controlling production. This committee should review and plan all production before even a sample is produced. It is advisable to review future or proposed orders on production, making sure that the designs of castings reviewed will fit into the plant's production system and equipment.

Production Begins

After a sample is made and reports from the technical and practical units are received, the planning committee should review these reports and make the necessary corrections if needed. The job then should be put into production for a trial run, making several castings which are to be checked in the same manner as the sample. If these are proven correct, full production can be released without the danger of any great loss, extra work, or cost for the cleaning room.

Inspection at the source having been discussed, some consideration should be given to inspection at the receiving point, meaning the customer.

As previously brought out, cost is increased when efficient inspection is lacking at the source of production; therefore, it is imperative to maintain a highly trained inspection personnel. This same principle applies to the customer's inspection. Cast steel is greatly used due to its adaptability to intricate designs and strength required. Of course, slight imperfections may occur, so, unless the customer's inspection personnel has the proper training and technical knowledge to pass upon minor defects and those of a more serious nature, considerable cost is involved, both to the customer and the producer.

In cases where intricate designs would cause trouble from a production standpoint, the customer should be contacted and advised why and where a few changes in design can be made without impairing the service or strength of the casting; or changing any machining operations should the casting be of such nature. These suggestions usually are agreeable to the customer and permission generally is granted to proceed with production.

Inspection Is Technical

As we all know, present inspection consists not only of surface inspection, gaging, checking of dimensions, etc., as in the past, but is rapidly becoming more and more of a technical nature. The use of magnetic particle testing, x-ray and various other specialized tests shows a decided change in inspection methods over the past few years and in prospect for the immediate future.

In the past decade or two, inspection procedures have expanded greatly to include many new phases that are the result of developments in technical researches. The foundry industry was at first a trifle slow in adopting and applying some of the developments, but of late years the industry as a whole has thrown off this backward attitude and the advances and improvements in processes and products have been phenomenal.

What has brought about this change in our industry? It is largely the result of widespread adoption and use of many new technical tools. For the most part, these new tools had been previously developed to a fairly high level of perfection, yet these tools usually were considered as laboratory playthings and not as production tools, referring to such things as x-ray, magnetic particle testing, and others.

Inspection Methods Familiar

Most foundrymen were somewhat familiar with these inspection methods, that is, they had heard or read of their uses, but very few of them had any actual experience in their use and many had never seen them in operation. Early in the war it was obvious that the foundry industry must step out and do things that normally it would not have thought possible. The demands of the armed services made it imperative that the industry accept these new laboratory tools and use them as means for development and improvements toward high quality castings.

Let us consider some of these new tools in more detail and see what their effect has been upon inspection procedures and upon quality of inspection. When we think of casting quality from the standpoint of soundness and freedom from internal defects, probably the most helpful tool for this purpose has been the use of radiography either by x-ray or radium.

Previously, the only way to determine the soundness of a casting was to destroy it—by cutting the casting into pieces to see what was inside it. This process was necessarily slow and costly and somewhat of a hit-or-miss proposition, for often the saw cut would not reveal the defect.

X-ray and Radium

X-ray and radium have been available to the foundry industry in a more or less limited way as an inspection tool since early in the 1920's. At first we were somewhat skeptical of its use in routine inspection processes; and today, after several years' experience, we still are not convinced that inspection of castings by x-ray is desirable or even justified, except in certain extreme cases. For instance, in aircraft construction, a casting failure might be the cause of a disaster, then 100 per cent radiographic inspection would be justified.

Radiography certainly has its place in the foundry industry, and it is the author's opinion that it is rapidly finding this place. Some proponents recommend that radiography should be used as a routine inspection procedure for inspection of castings, but from experience the author believes that radiography should be used primarily as a tool for development of production practices, and that producers of castings who have used radiography concur in this opinion. The indiscriminate use of x-ray or radium is costly and is wasteful of time, materials and personnel.

As we have come to consider radiography, its use should be largely limited to the inspection of sample castings to determine the internal defects not visible on the surface, and this information used to correct

the production practice so as to eliminate the defects found.

This procedure should be repeated until a sound casting is obtained. Periodic checks then should be made when the casting is put into production. The frequency of this checking and the thoroughness of its coverage can be gradually reduced as production proceeds and no trouble is experienced.

There may be certain extreme cases where the casting may be designed for such critical service that complete radiography of every casting produced would be justified. These cases are, in the author's opinion, very rare, and it goes without saying that in such cases the cost of the radiographic inspection must be passed along to the customer.

X-ray, of course, has its limitations. The thickness of the metal sections to be x-rayed are, of course, limited by the equipment available. The lower voltage machines around 220 kilovolts are limited to about 3 in. of steel; the larger machine, such as the 1000 kilovolt, can penetrate up to 7 in., while the 2000-kilovolt machine recently developed can penetrate up to 10 in. of steel.

Radiography

Radiography by gamma ray is not limited so sharply, its limitations being largely determined by the amount of radium and the time available. Another limitation of radiography is the size of defect found. It is generally conceded that the smallest defect that can be detected by x-ray or gamma ray is 2 per cent of the metal section. However, under ideal conditions, slightly better results can be obtained.

Another method of non-destructive casting inspection which has been widely accepted is magnetic particle testing. This method of testing has received much criticism and very stiff opposition in some quarters. Much of this criticism has, in the author's opinion, been deserved, for it is felt that much more has been expected of this test than it is capable of telling us. However, we do not mean to imply by this that magnetic particle testing does not have its proper place in modern inspection procedures.

Magnetic particle testing is limited to defects in the surface or defects relatively close to the surface

Written discussions of this paper are solicited for publication in future issues of "American Foundryman" and/or bound volume of "Transactions." Discussions should be sent to Secretary, American Foundrymen's Association, 222 West Adams St., Chicago 6.

of the casting. It is extremely sensitive to very small surface or subsurface cracks, and it is this characteristic that has been responsible for much of the criticism.

In the hands of inexperienced operators and in improper application, the patterns shown by magnetic particle testing may be made to look much worse than they really are. Those who have had experience with this tool will agree that it requires a well-trained and skilled operator to properly interpret the results.

Many castings are made today where magnetic particle testing is a valuable adjunct to the ordinary inspection methods. These are castings which are subject to high fatigue stresses. In castings designed for such service, it is imperative that the surface be free of all minute cracks or other imperfections which may be a focal point for stresses, thus causing early fatigue failure.

Much of the unpopularity of this type of inspection has been in its application to inspection of castings wherein the perfection demanded has not been justified by the end use of the casting inspected.

On the whole, it is felt that magnetic particle testing provides a valuable tool for better inspection of castings; it has a definite place in the modern and progressive foundry, for it helps to fill the gap between visual inspection and radiographic inspection.

The needs of war brought about many other changes in the foundry industry. Prominent among these is the widespread use of specially heat-treated alloy castings. This comparatively new foundry technique, to which many were introduced only since the beginning of the war period, involves several new testing and inspection techniques, among which is hardness testing.

Hardness testing of metals is, of course, not new. We used to think of hardness testing as applied only to small laboratory samples, but this new program of hardening large castings by liquid quenching made it necessary that we have some method of checking these heat-treating processes to make sure that the castings, as shipped, meet the specifications for hardness. For the most part, these hardness tests are made with a so-called portable Brinell tester.

This apparatus consists of a small fixture for holding a standard Brinell ball in contact with both the casting and a small bar of known hardness. The fixture is struck a sharp blow with a hammer, which produces simultaneously an impression in the bar and in the casting. The diameters of both of these impressions are measured. Knowing the hardness of the standard bar, the hardness of the casting can be calculated from the ratio of the impressions as measured.

This method of hardness measurement is, of course, subject to many errors, and under normal conditions is none too reliable for exacting work, yet it has been a definite help in obtaining castings of good quality and castings that meet customers' requirements.

Laboratory Tests

Often we do not think of our routine laboratory tests as being inspection procedures, but in reality they are a phase of inspection since they are made solely to insure the highest quality obtainable and to make certain that the product meets the customer's specifications.

The use of the metallurgical microscope for checking our heat-treating and melting processes is well established, and does not merit any lengthy discussion at this time other than to point out that it is an excellent example of laboratory equipment that is used to good advantage in the control of quality.

The tensile testing of steel has long since been a standard part of inspection procedure since it is universally required in practically all specifications. This method of testing has been quite highly developed for some time, and there has been very little added in late years except a few refinements in the equipment available. Some producers have been required to add stress-strain recorders to obtain certain data in connection with some alloy steel, but its

application is still somewhat limited.

Impact testing was developed several years ago, but has never been so widely used until the requirements of production made it necessary. The use of some ordnance material in extremely cold climates has indicated that steel may have radically different properties at these low temperatures than was indicated by tests made at room temperatures.

From this has developed some new techniques for testing the metal at temperatures as low as 40° F. below zero. This program has shown many interesting things to date and holds promise of many other developments for the future.

One other phase of inspection that may well be presented for consideration is the use of quality control charts. This is a comparatively new development in inspection which the Army Ordnance Department has been instrumental in bringing before the industry.

This is a system of statistical treatment of inspection results which is kept in chart form. These charts are based upon certain mathematical laws of probability, and in the treatment of large bodies of inspection data present a very good picture of past performance. These laws of probability made it possible to predict with reasonable certainty what future performance should be.

If these charts indicate at any time that performance is not following the predicted pattern, then some point in the process has gone "haywire" and requires immediate attention. Oftentimes, definite trends in results, one way or another, can be detected before the process actually goes out of control and, if the investigation is prompt and thorough, the trouble often can be found and corrected before it is too late.

The subject of quality control charts is quite large. A thorough discussion would be beyond the scope of this paper. Experience along these lines has not been extensive, but we have made a small beginning in this application and are finding the results interesting and helpful.

In conclusion, the author wishes to express appreciation for the valuable counsel and advice given in the preparation of this paper by R. O. Tibbals, Chief Process Inspector at the East St. Louis Works of the American Steel Foundries.

FOUNDRY SOCIETIES

Hold Joint Educational Meeting

On October 5, 1945, the first meeting of a Joint Committee on Education, the personnel of which is composed of four representatives from each of the following societies, Gray Iron Founders' Society, Steel Founders' Society of America, Malleable Founders' Society, and the American Foundrymen's Association, was held in Cleveland to discuss ways and means of improving knowledge of the foundry industry in the educational facilities of the country. At this committee meeting two subcommittees were appointed, one to work with and survey high school and trade school cooperation, and secondly, to establish closer relations with colleges and universities.

On January 23, the latter group held a meeting in Cleveland, at which the following members of the subcommittee were present: A. C. Denison, Fulton Foundry & Machine Co., Cleveland, representing Gray Iron Founders' Society; R. W. Cranell, Lehigh Foundries, Inc., Easton, Pa., representing the Malleable Founders' Society; S. C. Wasson, National Malleable & Steel Castings Co., Chicago, representing Malleable Founders' Society; F. G. Sefing, International Nickel Co., New York, representing American Foundrymen's Association; J. M. Price, Ferro Machine & Foundry Co., Cleveland, representing Gray Iron Founders' Society; and R. L. Collier, Executive Secretary, Steel Founders' Society of America, Cleveland.

Due to circumstances over which they had no control, C. W. Briggs, Steel Founders' Society of America, representing that organization, and Peter E. Kyle, Massachusetts Institute of Technology, Cambridge, Mass., representing American Foundrymen's Association, could not be present. In addition, H. S. Colby, Malleable Founders' Society; Anthony Haswell, Dayton Malleable Iron Co., Dayton, Ohio; J. H. Lansing, Malleable Founders' Society; and N. F. Hindle, American Foundrymen's Association, also were present.

Before the meeting was formally opened, Anthony Haswell, Dayton Malleable Iron Co., Dayton, Ohio, Chairman of the Joint Committee, outlined the duties of the subcommittee. The first order of business was the election of a Chairman and Secretary. Mr. Price was elected Chairman and Mr. Collier, Secretary.

Two objectives of the committee were stated: (1) to develop a suggested or tentative curriculum designed to meet the requirements of the foundry industry for college graduates better equipped for development to top foundry technicians and executives, (2) to determine whether such curriculum is practical from the standpoint of one or more universities, and to ascertain which of the leading engineering schools or colleges would be receptive to the establishment of such a course of study in their institutions. The first objective of the committee was discussed at great length and a tentative group of subjects selected which would be of vital interest to those who might enter the foundry industry from universities. The second objective was also discussed at length, and some six universities would be contacted in the preliminary work outlined in objective (2) to ascertain those institutions' attitude toward the proposed program. Members of the committee were assigned to contact the respective universities, who will present reports of their work at the next meeting of the committee, the time and place of which is to be designated by Chairman Price.

Defects Committee Is Editing Book Material

Regular monthly meeting of the Gray Iron Division Committee on Analysis of Casting Defects was held at the offices of the Association on January 19. The purpose of this meeting was to review and edit the various causes of defects in gray iron castings, and to prepare for a publication of these causes. It is hoped that this publication may be available before the 50th Annual Meeting.

According to present plans, two sessions of the Gray Iron Shop Operation Course will be under the direction of this committee.

★ NEW A. F. A. MEMBERS ★

*In the past month twenty-eight Chapter Membership Committees "went to town" reporting a total of 143 new members against 131 during the same period a year ago. Leading the list is Chicago with 27 new members. Runners-up are: Central Illinois, A.F.A. "baby chapter," 19; Ontario 14; and Eastern Canada 9.

(December 15, 1945 to January 15, 1946)

CANTON DISTRICT CHAPTER

R. L. Fasig, Asst. Works Mgr., The Ashland Malleable Iron Co., Ashland, Ohio.
T. H. Peng, Met. Engr., National Automotive Parts Mfg. Works, Chungking, China.

CENTRAL ILLINOIS CHAPTER

Robert H. Armstrong, Caterpillar Tractor Co., Peoria, Ill.
Fred G. Birwin, Foreman, Caterpillar Tractor Co., Peoria, Ill.
O. E. Bond, Mgr., Model Brass Co., Inc., Decatur, Ill.
Stroud K. Bratcher, Caterpillar Tractor Co., Peoria, Ill.
Gerald Davison, Fore., Caterpillar Tractor Co., Peoria, Ill.
Otha O. Gammon, Caterpillar Tractor Co., Peoria, Ill.
Richard L. Harris, Apprentice, Caterpillar Tractor Co., Peoria, Ill.
Adolph Klawitter, Supt., Peoria Foundry Div., M. H. Detrick Co., Peoria, Ill.
Ben E. Lewis, Foreman, Caterpillar Tractor Co., Peoria, Ill.
William Nebgen, Caterpillar Tractor Co., Peoria, Ill.
Bruce H. Norman, Coremaker, Caterpillar Tractor Co., Peoria, Ill.
C. E. Robinson, Excel Brass Foundry, Pekin, Ill.
R. Russell, Foreman, Caterpillar Tractor Co., Peoria, Ill.
Cass F. Salm, Vice Pres., Republic Coal & Coke Co., Peoria, Ill.
K. M. Smith, Fdry. Engr., Caterpillar Tractor Co., Peoria, Ill.
F. F. Streibich, Gen. Supt., R. Herschel Mfg. Co., E. Peoria, Ill.
Chester O. Swords, Foreman, Caterpillar Tractor, Peoria, Ill.
Clifton A. Taylor, Caterpillar Tractor Co., Peoria, Ill.
Ralph E. Wheadon, Foreman, Caterpillar Tractor Co., Peoria, Ill.

CENTRAL INDIANA CHAPTER

R. E. Allen, Federal Fdry. Co. Div., American Stove Co., Indianapolis.
Paul Brant, Sales Mgr., National Grinding Wheel Sales Co., Indianapolis.
Alfred D. Kernodll, Fdry. Fore., National Malleable & Steel Castings Co., Indianapolis.
John Millar, Foundry Supt., Fountain Foundry Corp., Veedersburg, Ind.
W. B. Slatery, Galem Chemical Co., San Francisco.
Alexander J. Toth, National Malleable & Steel Castings Co., Indianapolis.

CENTRAL NEW YORK CHAPTER

David Basch, Repr., Almin Ltd., Farnham Royal, Bucks, England.
Oliver S. Comstock, Foreman, Elmira Foundry Co., Elmira, N. Y.
Bernhardt F. Miller, Asst. Mgr., Elmira Foundry Co., Elmira, N. Y.

CENTRAL OHIO CHAPTER

George W. Parke, Buckeye Products Co., Cincinnati.

CHESAPEAKE CHAPTER

Herbert Eichwald, Sales, Joseph Dixon Crucible Co., Jersey City, N. J.
Donald A. Potter, Met., Naval Research Laboratory, Washington, D. C.
David M. Warren, Jr., The Gibson & Kirk Co., Baltimore, Md.
Dr. Carl A. Zapffe, Cons. Met., Baltimore, Md.

CHICAGO CHAPTER

William Bancsi, Foreman, Carnegie-Illinois Steel Corp., Chicago.
John J. Behen, Salesman, National Carbon Co., Chicago.
David Bradley, Apprentice, Carnegie-Illinois Steel Corp., Chicago.
Raymond W. Bunchek, Apprentice, Carnegie-Illinois Steel Corp., Chicago.
Leonard W. Dean, Con. Engr., Precision Casting Co., Chicago.
L. E. Everett, Sr. Engr., Lester B. Knight & Associates, Chicago.
Lawrence J. Farley, Fore., Carnegie-Illinois Steel Corp., Chicago.
C. W. Fredenburg, Salesman, Mayer & Oswald, Chicago.
Alphonse F. Guaccio, Continental Foundry & Machine Co., East Chicago, Ind.
Mauritz P. Johnson, Asst. to Fdry. Supt., Carnegie-Illinois Steel Corp., Chicago.
Roy J. Keeley, Gen. Fore., Carnegie-Illinois Steel Corp., Chicago.
Harland V. King, Foreman, Carnegie-Illinois Steel Corp., Chicago.
W. B. Libert, Met. Engr., Continental Foundry & Machine Co., East Chicago, Ind.
A. H. Lyman, Special Engr., Carnegie-Illinois Steel Corp., Chicago.
George L. Markert, Sales Engr., Fisher Furnace Co., Chicago.
Joseph D. May, Foreman, Brass Foundry, Crane Co., Chicago.
John Maynard, Apprentice, Carnegie-Illinois Steel Corp., Chicago.
*National Grinding Wheel Sales Co., Chicago. (David E. McGraw).
John O'Brien, National Grinding Wheel Sales Co., Chicago.
George Pengiel, Sales Repr., L. S. Cohen & Co. Inc., Chicago.
Leslie G. Probst, Fdry. Engr., National Engineering Co., Chicago.
Max Ryen, Sr. Engr., Lester B. Knight & Associates, Chicago.
Wm. B. Scott, Aurora Metal Co., Aurora, Ill.
Joseph Senko, National Grinding Wheel Sales Co., Chicago.
Victor C. Smith, National Grinding Wheel Sales Co., Chicago.
Arthur Vandenburg, C. R. Supv., Allied Steel Castings Co., Harvey, Ill.
C. Arthur Veach, Supt., Western Foundry Co., Chicago.

*Company Members.

CINCINNATI DISTRICT CHAPTER

Charles V. Appel, Met., The Bauer Bros. Co., Springfield, Ohio.
Ping-Kao Han, Cincinnati.
Marion F. Hunt, Molder Fore., Dayton Malleable Iron Co., Dayton, Ohio.
Irving Stephens, Supt., The Advance Foundry Co., Dayton, Ohio.

DETROIT CHAPTER

Lyle C. Beaudoin, Sales Repr., Chas. Taylor Sons Co., Cincinnati.
Crary Davis, Asst. Chief Met., Aluminum Co. of America, Detroit.
Earl R. Dickinson, Sales, Eastern Clay Products, Inc., Detroit.
Ralph F. Greene, Chemist & Met., Detroit Brass & Malleable Works, Detroit.
Rubie O. Harrell, Personnel & Labor Man, Packard Motor Car Co., Detroit.

EASTERN CANADA & NEWFOUNDLAND CHAPTER

T. C. Bermingham, Montreal Repr., J. Wagmann & Son Ltd., Toronto, Ont.
Arthur Bourassa, Fdry. Fore., Canada Iron Foundries, Three Rivers, Que.
Claude Bourassa, Werner G. Smith, Toronto, Ont.
William Davis, Fdry. Fore., Montreal Bronze Ltd., Montreal, Que.
C. S. Dinsmore, Mgr., Grenville Castings Ltd., Merrickville, Ont.
R. L. Guilmette, Prod. Dept. Clerk, La Compagine J. A. Gosselin Ltee., Drummondville, Que.
John Henry, Fdry. Supt., W. R. Cuthbert & Co., Montreal, Que.
J. W. Meier, Bureau of Mines, Ottawa, Que.
Harold Swift, Asst. Supt., Montreal Bronze Ltd., Montreal, Que.

METROPOLITAN CHAPTER

Bureau of Aeronautics, Technical Information Section, Washington, D. C.
Edmos Precision Casting Corp., Brooklyn, N. Y. (Lester W. Gott, Gen. Mgr.).
Ernest R. Conover, Serv. Mgr., Master Tool Co., Cleveland.
Dr. Daniel S. Eppelsheimer, Chief Phy. Met., Metal Hydrides Inc., Beverly, Mass.
James A. Kearney, Met., Crucible Steel Co. of America, Newark, N. J.

MEXICO CITY CHAPTER

Ing. John DeClarck, Tabasco No. 67, Mexico, D.F.
H. W. Franz, Tech. Repr., Union Carbide & Carbon Corp., New York.
Golando Bastida Frerra, Ex. Gaucho de Maguinaria, S.A. Mexico, D.F.
*Fundiciones De Hierro Y Acero, S.A. Mexico, D.F. (Manuel Goroeocha, Director).
Jose German Loya, Calk 2 Sur, Pueblo, Mexico.
Lecundino Ruiz, Dinawarca M 7F Dept. 5, Mexico, D.F.

MICHIANA CHAPTER

W. H. Gayton, Owner, G-M Brass & Aluminum Foundry Co., Benton Harbor, Mich.
John B. Guthery, Salesman, Pickands, Mather & Co., Chicago.

NORTHEASTERN OHIO CHAPTER

Donald R. Harper, Manufacturer's Representative, Cleveland.
George E. Miller, Asst. Sales Mgr., The Osborn Mfg. Co., Cleveland.

NORTHERN CALIFORNIA CHAPTER

John E. Bacon, Jr., Wilson & Geo. Meyer & Co., San Francisco.
*C. Gamlen, Gamlen Chemical Co., San Francisco.
William R. Skinner, Jr., App. Molder, Vulcan Iron Foundry, Oakland, Calif.
Chester P. Sobey, Quarterman Molder, U.S. Naval Ship Yard, Mare Island, Calif.

NORTHWESTERN PENNSYLVANIA CHAPTER

Robert Brunk, Asst. Fore., Electric Materials Co., North East, Pa.
Jas. D. Jolley, Fdry. Foreman, Mutual Foundry Co., Franklin, Pa.
Chas. Somerhalder, Patternmaker, Mutual Foundry Co., Franklin, Pa.
James S. Williams, Prod. Mgr., Mutual Foundry Co., Franklin, Pa.

ONTARIO CHAPTER

C. A. Cowell, Foreman, The De Laval Co. Ltd., Peterborough, Ont.
J. M. Cummings, Acting Hd. of Mining & Met., University of British Colombia, Vancouver, B. C.
Richard E. Dwor, Owner, Dwor Metal Co., Port Colborne, Ont.
Donald D. Hall, Prod. Supv., Massey-Harris Co. Ltd., Brantford, Ont.
Wilfred P. Hubbard, Melt. Supv., The McKinnon Industries Ltd., St. Catharines, Ont.
H. Hughes, Works Mgr., The James Morrison Brass Mfg. Co., Ltd., Toronto, Ont.
Walter H. Irwin, Sales Engr., Canada Metal Co. Ltd., Toronto, Ont.
H. M. Jack, Mgr., London Salvage & Trading Co., London, Ont.
John Keohn, Jr., Fdry. Engr., McKinnon Industries, St. Catharines, Ont.

George MacKinnon, Salesman, Metals & Alloys, Ltd., Leaside, Toronto, Ont.
J. Trueman Obee, G. I. Molding Fore., McKinnon Industries Ltd., St. Catharines, Ont.
Harold F. Plant, Foundry Process, McKinnon Industries Ltd., St. Catharines, Ont.
Irvin Rosen, Frankel Brothers Ltd., Toronto, Ont.
***Wells Foundry Ltd., London, Ont. (Walter Wells, Supt.).**

OREGON CHAPTER

Hugh H. Templeton, Salesman, Balfour, Guthrie & Co., Ltd., Portland, Ore.
Sig. H. Ostenson, Salesman, Woodbury Co., Portland, Ore.

PHILADELPHIA CHAPTER

John M. Anspach, Met., Eastern Malleable Iron Co., Wilmington, Del.
Paul W. Beck, Foreman, Bethlehem Steel Co., Bethlehem, Pa.
Robert W. Highley, Salesman, Harbison Walker Refractories Co., Philadelphia.
A. N. Kraft, Fdry. Mgr., Wilkening Mfg. Co., Philadelphia.
Jack Sokol, Asst. Fdry. Mgr., Wilkening Mfg. Co., Philadelphia.
Wm. S. Thomas, Fdry. Engr., Drexel Hill, Pa.

QUAD CITY CHAPTER

James Hoswell, National Grinding Wheel Sales Co., Moline, Ill.

ROCHESTER CHAPTER

Russell S. Charles, Process Engr., The Symington-Gould Corp., Rochester, N. Y.

ST. LOUIS DISTRICT CHAPTER

Chester Jones, Foreman, Key Co., East St. Louis. Ill.
Steve Rajeski, Foreman, Key Co., East St. Louis, Ill.
J. I. Struble, Sales, Hickman Williams & Co., St. Louis.

TEXAS CHAPTER

***American Brass Foundry, Ft. Worth, Texas. (John M. Bird, Owner).**

TOLEDO CHAPTER

H. K. Derby, Fdry. Supt., The Buckeye Traction Ditcher Co., Findlay, Ohio.

TWIN CITY CHAPTER

Roland E. Kistler, Mgr., R. E. Kistler Fire Brick Co., Minneapolis.
Philip L. Mattison, Salesman, Foundry Supply Co., Minneapolis.

*Company Members.

Mike Venier, Foundry Supt., White Machine Works, Eau Claire, Wis.
Donald White, White Machine Works, Eau Claire, Wis.

WESTERN MICHIGAN CHAPTER

Walter Millar, National Motor Service, South Haven, Mich.

WESTERN NEW YORK CHAPTER

Jas. E. Walsh, Asst. Fore., Worthington Pump & Machinery Corp., Buffalo, N. Y.

WISCONSIN CHAPTER

***Arneson Foundry Inc., Kenosha, Wis. (R. J. Arneson).**
H. E. Fellows, Wauwatosa, Wis.
A. E. Kliebhan, National Grinding Wheel Sales Co., Milwaukee.
Adolph James Popvich, Met., Allis Chalmers Mfg. Co., West Allis, Wis.

OUTSIDE OF CHAPTER

Vernon Creten, Atlas Foundry & Machine Co., Tacoma, Wash.
John W. Harvey, Factory Mgr., Kramer Machine & Engineering Products, Leavenworth, Kansas.
O. R. Rowe, Vice President, R. H. Bouligny, Inc., Charlotte, N. C.
Clarke W. Wilbur, Mech. Engr., Mexico Refractories Co., Grand Rapids, Mich.
Gumports Aktiebolog, Gotenborg, Sweden.
D. R. Andrews, Coord. Officer, British Steel Founders Assn., Sheffield, England.
John Bell, Proprietor, Albert Smith & Co., Glasgow, Scotland.
***George Blair & Co. Ltd., Newcastle-on-Tyne, 1, England. (George Blair, Mng. Dir.).**
***Kelvinator (Aust.) Ltd., Adelaide, South Australia. (Wm. Queale).**
Rene Kenner, Man. Director, Societe de Fonderie d'Aluminum n d'Alliageslegers (S.O.F.A.L.) Paris, France.
Antonio Lage, Owner, Usina Sta. Eugenia, Rio de Janiero, Brazil.
Thomas Lewander, Ingenior, Hugho Montgomery AB, Stockholm, Sweden.
Ivar Mathisen, Works Mgr., Sandnes Aduserverk, Sandnes, Norway.
John Montupet, Head Partner, Fonderies Montupet, Lannes, Paris XVI, France.
Albano Schmidt, Gen. Mgr. Fundicao Tupy, S.A. Santa Catharina, Brazil.
Robert Ronald Taylor, Robert Taylor & Co. (Iron) Ltd., Larbert, Stirlingshire, Scotland.
Robert Ronceray, Gen. Mgr., Ph. Bonvillain & E. Ronceray, Seine, France.
The Royal Netherlands Embassy, Economics Dept., Mexborough House, London W. 1, England.
Magnus Tigerschiold, Doctor h.c. Jernkontoret, Kungstradgardsgatan, Sweden.
William Turnbull, George Blair & Co., Ltd., Gateshead, England.
Union Miniere du Haut-Katanga, Elisabethville, Belgian Congo.
K. G. Westin, Fdry. Engr., A/B Westin & Backlund, Stockholm, Sweden.

Foundry Personalities

J. T. Llewellyn, president, Chicago Malleable Castings Co., Chicago, has been elected chairman of the board. He will be succeeded as president by **W. L. Beaudway,** formerly executive vice-president. **Leon J. Wise,** past chairman, Chicago chapter, was named assistant to the president. **L. F. Hartwig** has been made general manager and **O. P. Fehrenbach,** works manager.

John W. Leslie, president, Signode Steel Strapping Co., has been elected to the Board of Directors, American Foundry Equipment Co., Mishawaka, Ind.

Wm. B. Given, Jr., president, American Brake Shoe Co., New York, has announced the purchase of Joliette Steel Ltd., Joliette, Que.

Fred T. H. Youngman, formerly executive vice-president, has been elected president, Jessop Steel Co., Washington, Pa. He succeeds **R. Edson Emery,** who was made chairman of the board. Three new directors have been added to the Jessop board of directors. They are **W. C. Buchanan,** president, Globe Steel Tubes Co., Milwaukee; **Andrew J. Dallstream,** senior partner, Pam, Hurd & Reichmann, Chicago; and **Linwood A. Miller,** Chicago.

Louis S. Cates, president, Phelps Dodge Corp., New York, and **H. Donn Keresey,** president, Anaconda Wire & Cable Co., New York, have been named to serve on the nonferrous metals division of the Disabled American Veterans National Service Fund.

C. Q. Wright has returned to the Whiting Corp., Harvey, Ill., in the capacity of vice-president dealing with special staff work. Mr. Wright served as a submarine commander in World War II. He was vice-president in charge of sales until he left to join the U. S. Navy after Pearl Harbor.

Lt. Gen. Levin H. Campbell, army chief of ordnance (retired), has been elected a vice-president, International Harvester Co., effective March 1. Gen. Campbell will be a coordinator of the company's general physical expansion program.

C. Q. Wright

W. E. Mahin

Dr. Edward Uhler Condon has been appointed Director, National Bureau of Standards, Washington, D. C., succeeding **Dr. Lyman J. Briggs,** who is retiring.

W. E. Mahin, formerly Manager Metallurgical Engineering, Materials Engineering Department, Westinghouse Electric Corp., East Pittsburgh, Pa., has taken up a new position with the Armour Research

Foundation, Chicago, effective January 21, 1946. Mr. Mahin will act as Chairman of the Metals and Minerals Division of the Foundation. He is well-known to many A.F.A. members through his long connection with A.F.A. activities, especially in the field of Gray Iron.

H. C. Amtsberg, formerly Manager of the Metallurgical Application Section, has been appointed to the position at Westinghouse formerly occupied by Mr. Mahin.

L. L. Andrus, vice-president in charge of sales, American Foundry Equipment Co., Mishawaka, Ind., has announced a number of sales territorial changes. **A. H. Freeman,** formerly sales engineer, Detroit, has been appointed sales representative, Milwaukee. **Vernon S. Spears,** who had served in the Northern Indiana sales territory, is now sales representative for most of Indiana. **Charles E. Ludwig,** formerly sales representative, St. Louis, has been appointed sales representative, Buffalo, N. Y. **Donald E. Matthews,** formerly with Soreng-Mannegold Co., Chicago, has been named St. Louis territory sales representative. **Joseph F. Underway,** formerly field manager, East Texas Electric Steel Co., Longview, Texas, has been appointed sales representative with headquarters in Houston, Texas. **Robert A. Campbell** has been named Canadian sales engineer with headquarters in Toronto, Ont. He was formerly connected with Salem Engineering Ltd. **G. R. Bryant,** formerly a sales engineer, General Electric Co., is a sales engineer in the Detroit office. **John N. Harper** has been appointed sales representative with headquarters in Pittsburgh, Pa.

Gordon T. Williams, an A.F.A. member, has been named materials engineer in the Engineering Department, Pratt & Whitney Aircraft Div., United Aircraft Corp., East Hartford, Conn. **W. Paul Eddy, Jr.,** formerly materials engineer, was made chief of engineering operations.

N. A. Kahn, chief metallurgist, New York Naval Shipyard, New York, was awarded the Meritorious Civilian Service Award by the Navy Department on December 11, 1945.

N. A. Kahn

B. A. Irwin

J. O. Logan

H. P. Smith

This award was presented in appreciation of his outstanding services and achievements during World War II. The citation specifically relates his achievements in establishing foundry control procedures and in foundry development work which improved yield during the critical years of World War II and for his pioneering in the field of radium radiography.

Mr. Kahn is a charter member of the A.F.A. Metropolitan chapter.

Bruce A. Irwin has been appointed sales manager, Hammel-Dahl Co., Providence, R. I. He was formerly secretary, Petroleum Administration, War's Materials Coordinating Committee.

Jack W. Wheeler, formerly light metals consultant, Reynolds Metals Co., Springfield, Mass., has severed his Reynolds connection and now is established as a light metals consultant in Springfield under the name of Wheeler Consultancy.

Mr. Wheeler presented the British exchange paper at the 1944 A.F.A. Convention, on behalf of the author, and previously was head of the permanent mold foundries, Rolls Royce, England. He expects to remain in this country and is taking an active part in the A.F.A. Aluminum and Magnesium division.

Lee Woehlke, formerly core room superintendent, Spring City Div., Grede Foundries, Inc., Milwaukee, is now with Lakey Foundry & Machine Co., Muskegon, Mich.

Ralph H. Hopp has been appointed librarian, Battelle Memorial Institute, Columbus, Ohio. Prior to accepting his position with Battelle, Mr. Hopp was in charge of the technical information service, Bituminous Coal Research, Inc., Pittsburgh, Pa.

John O. Logan has been appointed an assistant general manager of sales. The Mathieson Alkali Works, Inc., New York. **Harry P. Smith** has been named New York district sales manager of that concern.

Victor Rowell recently joined the technical sales service, core oil division, Velsicol Corp., Chicago. He was formerly associated with the metallurgy department, Buick Motor Co., Flint, Mich.

R. J. Kelly, foundry superintendent, American Skein & Foundry Co., Racine, Wis., for the past 25 years, has resigned his position. Mr. Kelly is a charter member and former director of the A.F.A. Wisconsin chapter.

Harry Yehle, a former apprentice and journeyman at the Vilter Mfg. Co., Milwaukee, has been appointed foundry instructor at the American Seating Co., Grand Rapids, Mich.

Theodore C. Ekman has been appointed assistant factory manager, Peninsular Grinding Wheel Co., Detroit. Mr. Ekman joins Peninsular after serving thirty-two months in the U. S. Navy.

T. C. Ekman

J. W. Wheeler

★ CHAPTER ACTIVITIES ★

news

Wisconsin

J. G. Kropka,
Chain Belt Co.
Chapter Reporter

IN THE REGULAR monthly A.F.A. meeting held January 11, the steel group of the Wisconsin Chapter presented a discussion on, "Some Reconversion Problems of the Steel Foundry." Leroy E. Everett of the Lester B. Knight & Associates, Chicago, headlined the event.

Mr. Everett's talk covered two main points, starting with the importance of organization within the plant itself, establishing clear cut lines as to authority and responsibility, whereby morale is kept high, and production and quality are maintained. The second point covered the need for good equipment and its application, and correct utilization of floor space.

Mr. Everett pointed out that many plants have the proper modern equipment but fail to get the most out of it because the pace of the new equipment is set by some obsolete production procedure. One example given concerned a modern shakeout utilizing a wheelbarrow for removal of castings.

After his talk Mr. Everett showed and explained a number of slides of various foundry operations. He pointed out the good and the bad methods, and how a few simple rearrangements could result in improved operations.

In a joint session on malleable and gray iron, L. P. Robinson of Werner G. Smith Co., Cleveland, spoke on "Core Room Variables." Mr. Robinson pointed out that the type of sand used is of utmost importance. The sand and oil ratio should be closely watched, he stated, and will vary considerably according to the type of castings being made. Sand and oil ratios, the speaker said, vary from 30 to 1 to 80 to 1. The variation depends upon the type of mixer used as well as ovens and binders employed.

In using binders, Mr. Robinson stated, one should know their physical as well as chemical characteristics in order to obtain best results. Practically any binder can be used if its mixing and baking are controlled. In baking cores, in the old days the rule used to be one hour bake for each inch of sand. This rule still applies, although faster baking is done in continuous ovens.

Detroit

THE DETROIT CHAPTER, renewing the lecture series so successfully held prior to the war, recently completed a four weeks' Foundry Lecture Course. Outstanding talks and excellent attendance proved that local foundry management is taking full advantage of every opportunity to train its personnel.

Beginning on January 18, two sessions were held each week through February 8, four lectures being offered on gray iron, two on steel, one on aluminum and magnesium, and one on brass and bronze. W. B. McFerrin, Electro Metallurgical Co., was instrumental in organizing the work as Chairman of the Lecture Course Committee. Chapter Vice Chairman, A. H. Allen, Penton Publishing Co., acted as registrar, and all sessions were given at the Rackham Educational Memorial.

Men well known in the foundry industry addressed each session. Speakers on gray iron included:

N. F. Hindle, American Foundrymen's Association, on *"Design and Its Effect Upon Quality of Castings."*

Fred G. Sefing, International Nickel Co., on *"Molding, Gating and Heading."*

William Pennington, Carrier Corp., on *"Theoretical Cupola Operations."*

Harold Bement, Campbell, Wyant & Cannon Foundry Co., on *"Practical Cupola Operations."*

Speakers on steel, and their subjects were as follows:

Victor Zang, Unitcast Corp., on *"What Is Wrong in Steel Molding and Core Making?"*

H. Bogart, Ford Motor Co., on *"What Is Wrong in Steel Melting, Cleaning and Heat Treating."*

Speakers on non-ferrous metals, and their subjects:

W. B. George, R. Lavin & Son, on *"Defects in Brass and Bronze Castings."*

Les Brown, Magnesium Fabricators, Inc., on *"Aluminum and Magnesium Castings."*

Joe Risney and Everett Carpenter, chairman and co-chairman, Wisconsin chapter Christmas party.

(Photo courtesy John Bing, A. P. Green Fire Brick Co.)

Philadelphia

E. C. Troy,
Dodge Steel Co.
Chairman, Publicity Committee

MEMBERS of the Philadelphia Chapter of A.F.A. came out to the January 11 meeting in force to wel-

CHAPTER MEETINGS
FEBRUARY-MARCH

FEBRUARY 20

Twin City
Curtis Hotel, Minneapolis
L. F. TUCKER
City Pattern Works
"Cooperation Between Patternmaker and Foundry"

Connecticut Non-Ferrous Foundrymen's Association
Joseph Dixon Crucible Co.
"Recommended Practices in the Use of Crucibles"

FEBRUARY 21

Canton District
Mergus Restaurant, Canton
OLD TIMERS NIGHT AND ROUNDTABLE

Detroit
Rackham Educational Memorial
ROUNDTABLE

FEBRUARY 22

Ontario
Royal York Hotel, Toronto
H. F. TAYLOR
Naval Research Laboratory

FEBRUARY 23

Chicago
Stevens Hotel
ANNUAL LADIES' NIGHT

FEBRUARY 25

Northwestern Pennsylvania
Moose Club, Erie
TOM BARLOW
Battelle Memorial Institute
"Cupola Practice"

Central Ohio
Chittenden Hotel, Columbus
B. P. MULCAHY
Citizens Coke & Gas Utility
"Cupola Operations and Foundry Coke Specifications"

FEBRUARY 28

Michiana
Indiana Club, South Bend, Ind.
ANNUAL LADIES' NIGHT

MARCH 1

Chesapeake
Engineers Club, Baltimore, Md.
N. J. DUNBECK
Eastern Clay Products, Inc.
"Synthetic Sand"

Western New York
Hotel Touraine, Buffalo
MILTON P. SCHEMEL
Symington-Gould Corp.
"Modern Cleaning Room Practice"

MARCH 4

Central Indiana
Athenæum, Indianapolis
HENRY F. HAGEMEYER
Castings Patent Corp.
"Gating Theories in Practice"

MARCH 5

Michiana
Hotel Spaulding, Michigan City, Ind.
FRANK G. STEINEBACH
"The Foundry"

MARCH 7

Saginaw Valley
Fischer's Hotel, Frankenmuth, Mich.
J. A. GITZEN
Delta Oil Products Co.
"Core and Mold Washes"

MARCH 8

Wisconsin
Hotel Schroeder, Milwaukee
GENERAL MEETING

Northern California
Engineers Club, San Francisco
FRED G. SEFING
International Nickel Co.
"Gating and Risering"

Eastern Canada & Newfoundland
Mt. Royal Hotel, Montreal
QUIZ NIGHT

Philadelphia
Franklin Institute
DR. R. K. MARSHALL
Fels Planetarium
"Atomic Energy in War and Peace"

Central New York
Onondaga Hotel, Syracuse
HENRY C. WINTE
Worthington Pump & Machinery Corp.
"Gates and Risers for Sound Castings"

MARCH 11

Cincinnati District
Engineering Society Headquarters
Cincinnati
H. W. DIETERT
Harry W. Dietert Co.
"Mold Atmosphere"

MARCH 12

Rochester
Seneca Hotel, Rochester
B. L. SIMPSON
National Engineering Co.

MARCH 14

Texas
Fort Worth
Electro Metallurgical Corp.
"Foundry Practice as Related to Cast Steel"

St. Louis District
DeSoto Hotel, St. Louis
J. A. RASSENFOSS
American Steel Foundries
"The Importance of Sand Control and Sand Testing"

MARCH 15

Toledo
Toledo Yacht Club

MARCH 19

Twin City
Curtis Hotel, Minneapolis
FRANK ROSS
E. F. Houghton & Co.
"Lubrication and Maintenance Problems in a Foundry"

MARCH 21

Detroit
Rackham Educational Memorial
"Good Housekeeping in the Foundry"

(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

Two groups representative of those who celebrated the Wisconsin chapter Christmas party.

come their speaker of the evening Nathan Janco, Centrifugal Casting Machine Co., Tulsa, Okla. C. L. Lane, Florence Pipe & Foundry Co., acted as technical chairman and added to the meeting's success by his remarks on the use of the centrifugal method of casting.

Mr. Janco made clear the terminology regarding centrifugal casting by explaining the differences between true centrifugal casting, semi-centrifugal casting, and centrifuging. He discussed the advantages of centrifugal force as an aid in the manufacture of steel, iron and non-ferrous castings. Slides illustrated the various types of gating and risering which can be used.

Eastern Canada - Newfoundland

THE INITIATIVE in apprentice training has been assumed by the Eastern Canada and Newfoundland chapter as the result of a survey conducted recently. Returned servicemen receive a refresher course, and night school students obtain valuable instruction through the 1945-46 Educational course sponsored by the chapter at the Montreal Technical School's foundry, Montreal, Que., Canada.

Foundries unanimously agreed the Eastern Canada and Newfoundland chapter should assume responsibility for guiding and co-ordinating apprentice training and assisting the Provincial educational authorities, according to Chapter Chairman G. E. Tait, Dominion Engineering Works Ltd., Vice-Chairman Henry Louette, Warden King Ltd., and Director A. E. Cartwright, Robert Mitchell Co. Ltd. Plans are being made for a program of practical training in the apprentice's own shop with related training to be given in a school.

Under the chairmanship of Henry Louette, the chapter's Education committee has arranged a series of sound films depicting a variety of foundry operations. The films serve as a review for chapter members and returned servicemen. In addition they form part of the classroom instruction of evening courses in patternmaking and foundry practice organized earlier by the chapter. The evening courses are taught two nights a week from October 1, 1945 to March 1, 1946 to men already at work in local foundries. Costing only one dollar to others, the five film sessions are free to students and have been made available to ex-servicemen as well.

Central New York

John A. Feola,
Crouse-Hinds Co.
Chapter Reporter

THE CENTRAL NEW YORK CHAPTER, A.F.A., held its regular monthly dinner meeting at the Onondaga Hotel, Syracuse, on January 11. Chairman E. G. White, Crouse-Hinds Co., presided and introduced the speaker, M. T. Ganzauge, General Railway Signal Co., Rochester, N. Y.

Mr. Ganzauge, who is well known to the Central New York Chapter as one of the original members and was instrumental also in establishing the Rochester Chapter, was selected by the government as a member of a board to investigate German industrial capacity, particularly in the foundry industry, shortly after V-E day. Using slides made from photographs he had personally taken, the speaker gave a splendid description of his trip which included foundries and steel mills in several industrial districts of Germany, Austria and Czecho-Slovakia.

According to Mr. Ganzauge, Germany had performed considerable work with centrifugal castings. This was necessary because of the substitution of chrome-steel for bronze, which was very scarce. Castings of 1/32 in. sections were successfully cast centrifugally in steel, and gun barrel castings weighing tons also were turned out by this process.

Various types of molding and core sands used in European foundries were also described by Mr. Ganzauge, as well as methods of gating, sand conditioning, and mold handling. The blowing of cores was used more extensively in German coremaking than in this country, even small foundries having coreblowing equipment.

The speaker pointed out that the workers consisted primarily of girls, women and prisoners. Mechanized equipment was widely used and production schedules were surprisingly high for the type of help available.

Some of Mr. Ganzauge's slides were of bombed-out foundries and steel mills, showing the terrific destruction wrought by our aerial attacks. Nevertheless, according to their records, German casting production reached its peak in the fall of 1944.

By interspersing his technical descriptions with various non-technical sidelights, Mr. Ganzauge held attention throughout his talk. The high interest in the subject was evidenced by numerous questions at the conclusion of the lecture, and proved that this was one of the most interesting sessions the chapter has ever held.

St. Louis District

Lee H. Horneyer,
Industrial Specialties
Chapter Secretary-Treasurer

THE REGULAR MEETING of the St. Louis District Chapter, held on January 10, was opened by Chairman Walter E. Illig, Banner Iron Works, with an attendance of 85. Following the reading of minutes, R. T. Leisk, American Steel Foundries, as Chairman of the Program Committee gave a brief resume of the February meeting and requested members to invite their executives and guests to attend. Walter Zeis, Midwest Foundry Supply Co., Chairman of the Membership Committee, reported a membership of 215 as of January 10.

Chairman Illig introduced the speaker, A. C. Denison, president of Fulton Foundry & Machine Co., Cleveland, on the subject of "Castings versus Weldments." Mr. Denison first extended greetings from the Cleveland Chapter, giving a brief summary of plans for the National

Convention of A.F.A. in May, and extended an invitation to all to attend.

The speaker offered an interesting discussion of the merits of castings especially in the heavy machinery industry, emphasizing the following advantages: Rigidity, machinability without distortion, compression, wear resistance, damping properties, heat resistance, corrosion resistance, and lower cost of intricate design, especially where finish is necessary. He emphasized his points with slide illustrations.

Philadelphia

E. C. Troy,
Dodge Steel Co.
Chairman, Publicity Committee

THE SUBJECT "Cast Iron—A New Engineering Material" proved sufficiently provocative to attract 150 members and guests to the December 7 meeting of the Philadelphia Chapter, held at the Engineers Club, Philadelphia. Chapter Chairman John W. Robb, Jr., Hickman Williams Co., presided, and W. J. Diederichs, Autocar Co., acted as Technical Chairman and introduced the speaker.

In the absence of the paper's author, B. F. Shepard of Ingersoll Rand Co., Phillipsburg, N. J., in Europe at the time, Mr. Shepard's associate R. B. Fisher gave an excellent presentation, covering several phases of production control.

He stressed the possibilities of high tensile cast iron where such iron can be depended upon from casting to casting and from day to day, and pointed out that strength can be a suitable substitute for ductility in many engineering applications. In such applications, he said, the engineer would consider use of nonductible metals if he could rely on consistently high strength values in castings.

Mr. Fisher emphasized the need for foundry control to assure the engineer of uniformity in the high tensile irons. His remarks touched on proper analytical methods for carbon determination, proper use of alloys, and potentialities of heat treatments usually given only to steels.

The speaker offered an interesting story on gating practice, illustrated by a movie showing the action of molten metal in various gating arrangements. He ably pointed out the inconsistencies of foundry gating practice with well established fundamental hydraulic principles.

New England Association

Merton A. Hosmer,
Hunt-Spiller Mfg. Corp.
Association Reporter

CELEBRATING the 50th anniversary of the New England Foundrymen's Association, over 300 members and guests attended the group's annual meeting held January 9 at the Hotel Gardner, Boston. During the evening the election of officers and an Executive Committee was held, the following being elected:

President, B. W. Hagerman, Rice-Barton Corp., Worcester, Mass.; *Vice-President,* D. L. Parker, General Electric Co., Lynn, Mass.; *Treasurer,* Arthur W. Gibby, East Boston, Mass.; *Secretary,* Ernest F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass., reelected.

Members of the Executive Committee whose election was announced at the meeting include: Arthur F. Dockery, H. & B. American Machine Co., Pawtucket, R. I.; Frederick M. Fitzgerald, Draper Corp., Hopedale, Mass.; Thomas I. Curtin, Jr., Waltham Foundry Co., Waltham, Mass.; Thomas R. Walker, Warren Pipe Co. of Mass., Inc., Everett, Mass.; and Charles A. Reed, Rogers-Brown-Lavino Co., Cambridge, Mass.

President M. A. Hosmer, Hunt-Spiller Mfg. Co., Boston, presided at the Golden Anniversary celebration, at which no formal talks were presented. The group voted to hold the Sixth New England Regional Conference, March 29-30, at Massachusetts Institute of Technology. Walter M. Saunders, Jr., was chosen chairman, and M. A. Hosmer vice chairman of the Conference Committee.

Cincinnati District

Wm. H. Hoppenjans, Jr.,
Star Foundry Co.
Chapter Secretary

WITH A PROGRAM dedicated to "the future foundrymen of America" 80 members and guests of the Cincinnati Chapter attended the regular monthly meeting, held January 14 at Engineering Society Headquarters, Cincinnati. The program was directed to the attention of students and educational counselors of high schools and colleges in the chapter area, and 14 school representatives were present as chapter guests.

Chapter Chairman A. W. Schneble, Sr., The Advance Foundry Co., welcomed the students and instructors, along with past chairman Ed. King, Hill & Griffith Co. Mr. King pointed out the need for high caliber recruits in the castings industry.

Speaker of the evening Tom Barlow, Battelle Memorial Institute, Columbus, Ohio, presented an informative and entertaining talk on "Cupola Practice." He made a particular appeal for closer foundry supervision so as to obtain continuously reproducible results from the cupola, instead of blaming "unpredictable factors" for its vagaries.

As a result of the high interest shown by students and school authorities present, the chapter expects to make similar "educational nights" a regular feature of future meetings.

Eastern Canada - Newfoundland

G. D. Turnbull,
Canadian Car & Foundry Co. Ltd.,
Chairman, Publicity Committee

THE REGULAR MONTHLY MEETING of the Eastern Canada and Newfoundland Chapter of A.F.A. was held at the Mount Royal Hotel, Montreal, on January 11, the occasion being National Officers' Night. Guests of the chapter were National A.F.A. President F. J. Walls, International Nickel Co., Detroit, and Herbert F. Scobie, member of the Association's National Headquarters Staff, Chicago. Mr. Scobie is engaged in working out the extensive educational program of A.F.A.

President Walls, speaker of the evening, spoke at length on "Youth in the Foundry Industry." In the course of his remarks he stated that there is a shortage of 250,000 men in the foundry industry of the United States, and he then developed means of inducing the youth of the nation to become associated with the castings industry.

Among many valid and sound suggestions which President Walls offered was the point that foundry education of some form should be offered boys of grade school age, in the same way that manual training has been available for many years.

He expressed the belief that many boys thus would be directed to the foundries by persuasion and basic training rather than by economic necessity alone.

Mr. Scobie, who has been assigned the responsibility for developing the educational phases of the Association's Technical Development Program, discussed some of the activities now under way nationally. In particular, he stressed the major need for general public education to the necessity and importance of castings in the national fabric.

The Chapter's vote of thanks to the speakers was offered by A. E. Cartwright, Robert Mitchell Co. Ltd., St. Laurent, Que., Chapter Chairman, G. Ewing Tait, Dominion Engineering Works Ltd., Lachine, Que. Marking the special occasion in a suitable manner, the evening closed with light refreshments.

Wisconsin

COOPERATION with engineering schools, according to a plan which could be followed profitably by other chapters, was discussed at a meeting of the Educational committee of the Wisconsin chapter, January 25 at the Schroeder Hotel, Milwaukee. Under the chairmanship of D. C. Zuege, Sivyer Steel Casting Co., Milwaukee, the committee discussed a plan for sending two young men annually to the University of Wisconsin, Madison, to study metallurgy; made arrangements for demonstrations to be given in the University of Wisconsin foundry; and discussed a lecture series for Marquette University, Milwaukee.

The committee tentatively arranged to select from Wisconsin foundries two young men who show promise as foundrymen and who meet the entrance requirements of the university. These young men will work part time in the department of metallurgy as laboratory assistants while studying a four year course in metallurgy with special emphasis on foundry practice. Graduates under this plan are expected to return to the foundry industry with renewed enthusiasm and greater ability to solve foundry problems.

Experienced foundrymen will deliver laboratory lectures and demonstrate foundry technique at the University of Wisconsin to supplement the regular foundry course now being given to over 150 engineering students. Appearing at two-week intervals before small classes of about 15 students, industrial foundryman will conduct six sessions on Sand Testing, Bench and Floor Molding, Core Making, Cupola Operation, Brass and Bronze Practice, and Electric Furnace Steel Melting. Classes will last two hours in all cases except the furnace heats which will last four hours.

The lecture series to be given by members of the Wisconsin chapter at Marquette University will probably be presented before student engineering societies in accordance with tenative arrangements made by the Educational committee.

Assistance of the type discussed in this meeting was incorporated in the A.F.A. National Educational Program as the result of a survey of engineering college deans. Outlined in the January AMERICAN FOUNDRYMAN and discussed in the February issue, aid of this type forms an excellent basis for cooperation between A.F.A. chapter educational committees and engineering schools.

Metropolitan

C. J. Law,
Worthington Pump & Machinery Corp.,
Chapter Reporter

APPROXIMATELY 100 MEMBERS attended the January 7 "National Officers' Night" meeting of the Metropolitan chapter, held at the Essex House, Newark, N. J. National President Fred J. Walls, International Nickel Co., Detroit, was on hand to discuss some of the aims and accomplishments of the Association, National Director Harold H. Judson, Goulds Pumps, Inc., Seneca Falls, N. Y., was present and he extended greetings on behalf of other A.F.A. chapters.

T. D. Parker, Climax Molybdenum Co., New York, as immediate past president of the chapter, was presented with a token of appreciation for his services to the group. N. A. Kahn, principal metallurgist, New York Naval Ship Yard, New York, was introduced by Chapter Chairman Horace A. Deane, American Brake Shoe Co., as one of the few civilians decorated for outstanding work in the war effort.

T. J. Wood, American Brake Shoe Co., as Technical Chairman, introduced the speaker of the evening, James S. Vanick, research metallurgist, International Nickel Co., who gave a talk on "Modern Cast Iron." Mr. Vanick detailed progress made in controlling and adjusting the graphite formation of cast iron through the use of inoculants and alloying elements, so as to produce the particular characteristics desired by the application engineer, such as high strength, wear resistance, corrosion resistance, and heat resistance.

The so-called "captive" foundries have taken, and must continue to take, the initiative in developing the ultimate in cast iron, Mr. Vanick brought out, and in convincing engineers and designers that modern cast irons have possibilities which must not be overlooked. Attention was called to the excellent work being done by Allis-Chalmers Mfg. Co., West Allis, Wis., in producing drying rolls of cast iron for use under pressure and temperature conditions which until recently were considered impossible.

Those who attended the meeting agreed with Mr. Vanick's expression of respect for cast iron which, despite the beatings it has taken time and again from other materials, has always come back with renewed life and vigor.

Connecticut Non-Ferrous

Louis G. Tarantino,
Niagara Falls Smelting & Refining Corp.
Association Secretary

S. W. CHAPPELL, SR., Electric Boat Co., Groton, Conn., was elected President of the Connecticut Non-Ferrous Foundrymen's Association at the group's December 19 meeting, held at the Hotel Taft, New Haven. At the same time Joseph Shannon, Jenkins Bros. Co., Bridgeport, was elected Vice President.

Other officers selected by the group included: Treasurer, George S. King, Malleable Iron Fittings Co., Branford, Conn., Secretary, Louis G Tarantino, Niagara Falls Smelting & Refining Corp., New Haven, Technical Secretary, Frank D. Diana, Whipple & Choate Co., Bridgeport.

Elected to the Executive Committee were the following: Walter J. Kenney, North & Judd Co., New Britain; Earnest F. Stone, Manning

Maxwell & Moore Co., Bridgeport; D. Wesley Case, Belknap Mfg. Co., Bridgeport; Howard A. Phelps, Knapp Foundry Co., Guilford; T. Joseph Judge, Jenkins Bros. Co., Bridgeport.

Following the elections, the evening was devoted to a round-table discussion of various non-ferrous problems and to planning technical meetings for the year ahead.

Northern California

EDUCATIONAL COMMITTEES are being formed by many A.F.A. chapters. These committees are expected to serve as connecting links between the chapters and educational institutions, for sponsoring exhibits of foundry products, maintaining newspaper contact, and promoting the Association's national educational program. Names and addresses of chapter educational committee members will be published in an early issue of AMERICAN FOUNDRYMAN to facilitate exchange of information between the various chapters.

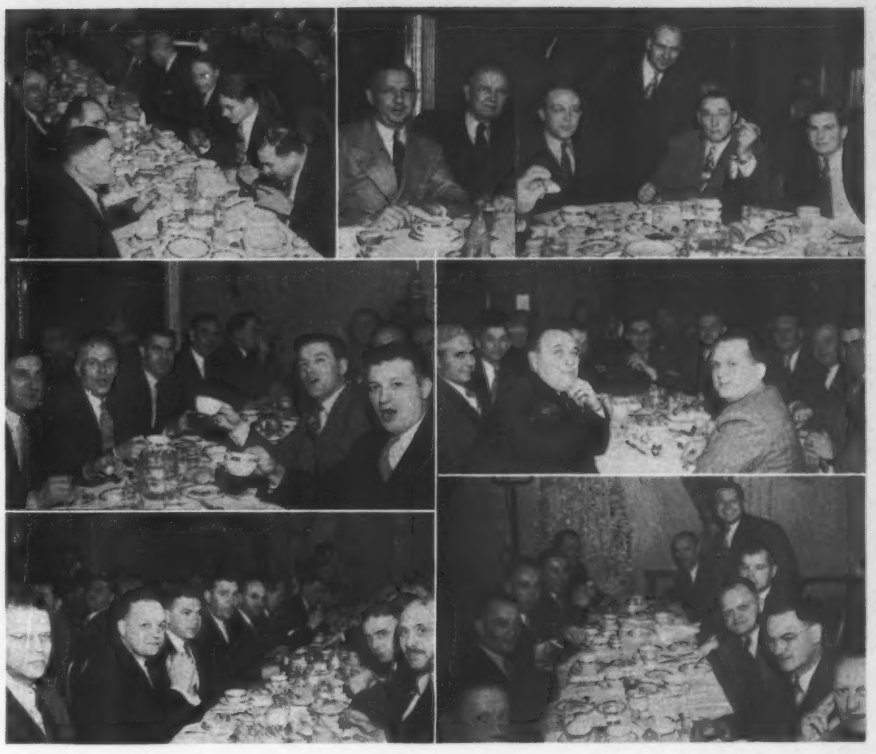
Formation of an educational committee was announced recently by the Northern California chapter. Headed by S. D. Russell, Phoenix Iron Works, chairman, the committee consists of Donald L. Mason, Stanford University; Daniel Gallagher, Daniel Gallagher Draying & Foundry Supplies; Charles J. P. Hoehn, Enterprise Engine and Foundry Co.; Ralph Hultgren, University of California (Berkeley) and Harry A. Bossi, H. C. Macaulay Foundry Co.

Twin City

Paul Hesse,
Union Brass & Metal Mfg. Co.
Chapter Reporter

THE TWIN CITY CHAPTER Entertainment Committee did itself proud in planning and arranging the Chapter Christmas party, held December 20 at the Radisson Hotel, Minneapolis. Prime movers on the committee were: Ned Frost, E. R. Frost Co., Minneapolis; Clarence Becker, Union Brass & Metal Mfg. Co., St. Paul; Shelly Pufahl, Pufahl & Sons, St. Paul; Paul Richardson, D. W. Onan & Sons, Minneapolis; and H. M. Patton, American Hoist & Derrick Co., St. Paul.

Everyone came prepared for a good time and certainly had one. A "social" hour preceded the dinner, which called for a sumptuous buffet supper in the main ballroom. The menu included everything from baked ham and turkey to meat balls and French fried shrimp.



(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

Good fellowship and frivolity were the keynote of Wisconsin's annual Christmas party.

After satisfying their appetites the foundrymen gave vent to their inner feelings by bursting out in song. They followed the bouncing ball through such old favorites as "Beer Barrel Polka," "Sweet Adeline," and "She was only a Molder's Helper, but Gad how that Woman could Cook." Francis Marrin, Marrin Foundry, Minneapolis, and Dick Smith, Sterling Wheelbarrow Co., took advantage of the situation to practice amateur choral direction.

Further entertainment was provided by M. C. Bud Jacobson and his show. Some prominent citizens found that Bud's hand is quicker than the eye.

Rochester

Donald E. Webster,
American Laundry Machinery Co.,
Chairman, Publicity Committee

NATIONAL OFFICERS' NIGHT was observed by the Rochester Chapter on January 8, when some 90 members and guests gathered at the Hotel Seneca, Rochester, for dinner.

The Chapter was honored by the presence of National President Fred J. Walls, International Nickel Co., Detroit. Mr. Walls reported on the standing of the national organization and told something of the Association's plans under way for the future. He described some further publications now being prepared, and stated that the coming 50th Anniversary Foundry Congress in Cleveland gives promise of being the largest and finest ever staged by the Association. President Walls declared that one of the greatest needs of the industry is to bring in younger men, and he strongly urged that foundrymen interest their sons in careers in the foundry.

M. T. Ganzauge, General Railway Signal Co., Rochester, a member of the Chapter board, presented a fascinating account of his recent experiences in Germany. Sent there by the U. S. Government to make a comprehensive study of various phases of the foundry industry, his report covered not only details of foundry practice but also personal experiences and observations. A number of excellent slides illustrated his talk.

Secretary Carl Johnson reported

on the progress and growth of the Rochester Chapter during 1945. Guests on this occasion included J. R. Wark, Queen City Sand & Supply Co., of the Western New York Chapter; C. K. Smith, Flight Officer, U. S. Air Corps; W. R. Rourke and R. L. Dobrin, of Osborn Mfg. Co., and Paul Hogan, Gulf Oil Co., Venezuela.

National President Fred J. Walls, International Nickel Co., Detroit, is pictured above with Rochester chapter officers. He was present at that chapter's National Officers Night meeting. Seated (left) Fred J. Walls and M. T. Ganzauge, General Railway Signal Co., Rochester, chapter director and speaker. Standing (left) Walter G. Brayer, Bausch & Lomb Optical Co., Rochester, chapter vice-chairman, and Carl B. Johnson, Symington-Gould Corp., Rochester, chapter secretary-treasurer.

Southern California

James B. Morey,
International Nickel Co., Inc.,
Chairman, Publicity Committee

ONE OF THE FINEST non-ferrous talks of the current season was given before the Southern California Chapter of A.F.A. at its monthly meeting, January 11, by George K. Dreher, Ampco Metals, Inc., Milwaukee, on "A Practical Approach to Bronze." Over 100 foundrymen and associates attended the event, held at a new meeting place, the Roger Young Auditorium, in Los Angeles. Judging from the favorable comments received from every quarter, this new arrangement may prove eminently satisfactory.

Mr. Dreher, a National Director of A.F.A., comprehensively covered all phases of the application of various bronzes to machine tool components such as bearings, as well as other modern industrial machinery. He stressed the necessity for employing clean home scrap in preparing bronze mixes, and gave considerable time to a discussion of heading and gating molds. Interesting items such as the solidification of the metal and the use of ceramic risers, as well as non-sand molds, were mentioned.

The speaker brought out some most interesting points concerning high-tensile aluminum bronze. The motion picture on the highlights of copper base alloys, called "Golden Horizons," added much to the evening's success.

Pictures taken at Wisconsin chapter's Christmas party.
(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

Northwestern Pennsylvania

A SPECIAL MEETING of the Northwestern Pennsylvania Chapter was held January 17 at the Franklin Club in Franklin, Pa., at the Exchange Hotel, attended by over fifty A.F.A. members and guests from Franklin, Grove City, Oil City and Erie. Several students from the local high school also were present.

Director T. H. Beaulac, Chicago Pneumatic Tool Co., Franklin, presided at the meeting, and introduced Vice-Chairman Earl M. Strick, Erie Malleable Iron Co.; Secretary H. L. Gebhardt, United Oil Mfg. Co.; and Chapter Directors William J. Miller, Frederic B. Stevens, Inc.; and Kenneth T. Guyer, Cascade Foundry Co. Mr. Beaulac explained that the meeting was held away from Erie so as to give foundrymen in the Venango County area an opportunity to participate more fully in activities of the Erie Chapter.

H. F. Scobie of the National A.F.A. Office, Chicago, addressed the meeting, outlining the Association's national educational program. He mentioned some publicity and educational activities carried on successfully by chapters, and suggested steps that might be taken by local foundrymen. Mr. Scobie reviewed the standard four-year apprentice training program, short term training, and upgrading systems.

An enthusiastic question and

answer period followed, indicating considerable local interest in the national educational program. Plans were made for building up newspaper publicity, and for establishing castings exhibit in local schools.

L. A. Dunn, General Electric Co., and John R. Metcalf, Erie Malleable Iron Co., of the Chapter's Technical Educational Committee, met January 18 to discuss educational projects. In addition to securing the cooperation of the local technical school in instituting a foundry course, Chairman Dunn stated that the Committee has been active in promoting a general educational and publicity program.

Central Illinois

C. W. Wade,
Caterpillar Tractor Co.,
Chapter Secretary

THE SECOND REGULAR MEETING of the newly organized Central Illinois Chapter of A.F.A. was held January 21 at the Jefferson Hotel, Peoria, Ill. One hundred members and guests from Peoria and nearby cities were in attendance to hear J. A. Gitzen, Delta Oil Products Co., Milwaukee, discuss "The Chemical and Physical Properties of Core and Mold Binders."

Chapter Chairman Ed Roby, Peoria Malleable Castings Co., presided and introduced Mr. Gitzen. The speaker illustrated his talk with numerous specific problems he has encountered during the many years he has been connected with the foundry industry.

Northern California

Charles R. Marshall,
Chamberlain Co.,
Chairman, Publicity Committee

JAMES E. GLIDEWELL, Assistant Chief Engineer, Hall Scott Motor Car Co., Berkeley, was the speaker at the Northern California Chapter's meeting December 10, held at the Engineers' Club, San Francisco. Mr. Glidewell was introduced by Program Chairman Andrew M. Ondreyco, Vulcan Foundry Co.

While the announced title of the speaker's talk was "Casting Design and Selection of Materials," Mr. Glidewell said his subject could better be described as an answer to the foundrymen's query "Why do you design those screwy castings?" The answer, according to "Speed" Glidewell, is simple.

All that is necessary in designing a truck engine, for example, is to consider limitations in size such as a maximum width of 28 in., limitations in weight of 76,000 lb. gross, and the horsepower desired, and from these data figure the size bore, crankshaft, piston, bearing area, etc. With this in mind the castings should be designed with sufficient strength and with enough bosses to tie the engine together and enough pads to hang on all the pumps, generators, cleaners, etc., that a modern engine demands. The result is, more than likely, a bunch of "screwy castings" —but the engine delivers the desired performance!

The talk was followed by slides and questions, with the speaker himself stumping the audience with this one: "Why is it, when discussing a drawing, a patternmaker always turns the darn think upside down?" He also announced that one of their engineers had discovered that the cause of the porosity which the machinists occasionally unearth is none other than cast iron termites.

Chapter President Charles Hoehn, Jr., Enterprise Engine & Foundry Co., announced the appointment of new officers to fill the vacancies left by the recent resignation of George L. Kennard, formerly Chapter Secretary-Treasurer. J. F. Aicher, E. A. Wilcox Co., has been appointed Secretary, and Jack K. Benedict, Donald Kenneth Co., Treasurer.

Other new appointments announced by President Hoehn: Attendance Chairman, David B. Reeder, Electro Metallurgical Sales Corp.; Sand Committee Chairman, George W. Stewart, Pacific Brass Foundry of San Francisco; Publicity Chairman, Charles R. Marshall, Chamberlain Co.

New England Association

M. A. Hosmer,
Hunt-Spiller Mfg. Corp.,
President, New England Foundry Group

APPROXIMATELY 100 MEMBERS and guests of the New England Foundrymen's Association attended the regular monthly meeting held at the Engineers' Club, Boston, December 12. This being the final meeting of 1945, a Nominating Committee was appointed to nominate candidates for officers during 1946. Appointed to the Committee were R. F. Harrington, Hunt-Spiller Mfg. Corp., Ray Meader, Whitin Machine Co., Walter M. Saunders, Jr., Walter M. Saunders Company.

Edward E. Kuypers, Personnel Director of First National Stores, Inc., Somerville, Mass., delivered the principal address on "Understanding Management-Labor Problems." An outstanding lecturer on personnel work, Mr. Kuypers stated that it has been difficult under present trying circumstances to maintain the American way of life. Industry, in putting money to work, contributes to the welfare and assures a better standard of living for all.

The paramount question today, according to the author, seems to be whether or not we can still ad-

Central Indiana Christmas party was well attended and greatly enjoyed.
(Photos courtesy B. P. Mulcahy, Citizens Gas & Coke Utility)

vance toward a better standard of living. He urged Management to take a more active interest in the welfare of the shop workers to the end that their productive capacities will be fully utilized.

Toledo

R. B. Bunting,
Bunting Brass & Bronze Co.,
Chairman, Publicity Committee

STEVEN GARRY, General Core Room Foreman, the Caterpillar Tractor Co., Peoria, Ill., was the principal speaker at the December meeting of the Toledo Chapter. Mr. Garry, choosing as his subject "An Engineer of Human Relations," emphasized the great importance of the conference type of training course for supervisors.

Stating that under present day conditions management's chief problem is how to interest the foundry worker in his job, Mr. Garry placed full responsibilities for agreeable labor conditions squarely on the supervisors' shoulders. He urged all supervisors to become genuinely interested in their workers.

A foreman must be versatile, he said . . . cooperative, patient, loyal and helpful at all times. To enable the supervisor to overcome any shortcomings along these lines, management has come to realize the great importance of training supervisors, and has found the conference method superior to other types.

In Mr. Garry's opinion, proper training given the supervisor in group discussions sends him back to his department with qualities of leadership vastly improved. His approach to employees is better, for he is more sure of the numerous answers he must give as a representative of top management. Thus he becomes an "engineer of human relations."

A short "Coffee Talk" in a humorous vein was given by Municipal Court Judge Harvey Straub. Herbert S. Scobie of the Chicago headquarters of the Association was on hand to give the Chapter members first hand information on the educational features of the Technical Development Program.

Central Ohio

Karol Whitlatch,
Aetna Fire Brick Co.
Chapter Secretary

DIVIDING HIS TALK into two sections, the first dealing with the engineering aspects of sand and the second the specific properties of all type of binding materials and auxiliary agents which are added to sand, Earl E. Woodliff, Foundry Sand Engineering Co., Detroit, addressed the Central Ohio chapter on December 17. The topic was "An Engineer Looks at Sands and Binders."

In the first part of the discussion, the speaker presented the effect of the physical properties of sand such as size, shape and surface. The physical reactions of sand as to mechanical breakdown and expansion was discussed.

The values of the materials were clearly illustrated by three charts in the second section of the lecture.

Western New York

Leo A. Merryman,
Tonawanda Iron Corp.,
No. Tonawanda, N. Y.

MEETING at the Hotel Touraine, Buffalo, N. Y., December 7 for the regular monthly gathering of the Western New York chapter, 102 members and guests were treated to a talk on "Core and Mold Facings" by J. A. Gitzen, Delta Oil Products Co., Milwaukee. Chapter Chairman Arthur H. Suckow, Symington-Gould Corp., introduced the speaker.

Mr. Gitzen covered his subject thoroughly, beginning with an historical outline and development of the various types of core binders, such as those derived from cereals, papermill by-products and petroleum. He brought out the advantages and disadvantages of different binders and the purposes for which they are used, and discussed the development of the modern blended core oils for general foundry use. Also covered in the talk were such inorganic materials as clay, silica flour and bentonite, for use with cores subject to high temperatures

Pictures taken at Wisconsin chapter's Christmas party.

(Photos courtesy John Bing, A. P. Green Fire Brick Co.)

and for improving green strength.

The speaker stressed the importance of careful supervision in the mixing of core sand. In spite of all the care used in the selection of materials, defective cores too often result from careless mixing of the sand, he said, although no operation is more important than mixing.

Another stated reason for failure is under-baking of the cores. The baking operation should thoroughly oxidize the binder, Mr. Gitzen declared. The group was told about a fast-baking process developed to bake certain cores in a matter of minutes instead of hours, by pulling hot air through the cores and thus speeding up oxidation of the binder.

On the subject of core washes, the speaker pointed out that a good core wash should be highly refractory, possess high hot strength, and should seal the surface of the core so that gas is forced to pass out through the vents or the backing sand of the mold. Interest in Mr. Gitzen's subject was indicated by a lively question and answer session.

Birmingham District

J. P. McClendon,
Stockham Pipe Fittings Company,
Chairman, Publicity Committee

DR. JAMES T. MACKENZIE of American Cast Iron Pipe Company, Birmingham, was the featured speaker at the November 16 meeting of the Birmingham District Chapter held at the Tutwiler Hotel with 92 members present.

The speaker's subject was "The Development of Centrifugal Casting in Europe up to the end of the War." Dr. MacKenzie was a member of a Government Commission sent to Europe for investigation of centrifugal casting developments and presented such interesting facts on his trip as have been released by the War Department. It is hoped that additional information will be released shortly for publication in more extensive form.

Mexico City

TEMPORARY OFFICERS and directors of the Mexican Chapter, 32d chapter of A.F.A., were elected at a meeting held in Mexico City November 19, as follows: President Ing. Ernesto Villalobos, Cia. Constructora de Maquinaria, S.A.; Secretary N. S. Covacevich; Treasurer Ing. F. Vargas Gonzalez; Directors Ing. Manuel Goycoechea, General Manager Hierro Maleable de Mexico and Ing. E. Macias Souza, Fundicion y Talleres America, S.A.

Secretary Covacevich reports that the foundrymen in Mexico are highly enthusiastic over the new chapter and are showing a great willingness to cooperate in every possible way, and that a spirit of mutual cooperation and friendship is developing more fully than ever before.

The chapter has commenced the issuance of a small mimeographed bulletin covering activities of the group and its members, and already is at work framing a set of by-laws under which the new organization will operate.

Central Indiana

B. P. Mulcahy,
Citizens Gas & Coke Utility
Chapter Historian

SUBJECT OF DISCUSSION at the December 3 meeting of the Central Indiana chapter was "Foundry Sands." This was presented by A. C. Den Breejen, Hydro-Blast Corp., Chicago.

Mr. Den Breejen discussed sand characteristics and by means of colored slides showed the different sand characteristics. The application of hydrochloric acid for the determination of limestone in sand was commented upon.

Eastern Canada-Newfoundland

G. D. Turnbull,
Shawinigan Foundries Ltd.
Chairman, Publicity Committee

THE DECEMBER MEETING of the Eastern Canada and Newfoundland chapter was a Christmas dinner dance held in the Mount Royal Hotel, Montreal.

The evening opened with an excellent dinner and was followed by a highly entertaining floor show. The balance of the evening was spent dancing. G. Ewing Tait, Dominion Engineering Works, Lachine, Que., chapter chairman, presided and introduced the guests of the evening, among whom were National Director J. Sully, Sully Brass Foundry, Ltd., Toronto, Ont.

Wisconsin

Walter Gerlinger,
Walter Gerlinger, Inc.
Chairman, Publicity Committee

MEETING at the Schroeder Hotel, Milwaukee, December 14, some 780 regional foundrymen relaxed and enjoyed the annual

Dr. Ralph Lee, General Motors Corp., Detroit (center, seated), was the guest speaker at the joint meeting of the A.F.A. Rochester chapter and the ASM Rochester chapter held December 11. Others in the picture are (seated, left to right) A.F.A. Chapter President W. F. Morton, The Anstice Co., Inc., Rochester; Dr. Lee; and ASM Chapter President Vernon H. Patterson. (Standing, left to right)—A.F.A. Chapter Secretary-Treasurer Carl B. Johnson, Symington-Gould Corp., Rochester, and A.F.A. Chapter Vice-President Walter G. Brayer, Bausch & Lomb Optical Co., Rochester.

Christmas party of the Wisconsin chapter. An excellent dinner was served, followed by a first-class floor show.

Rochester

Donald E. Webster,
American Laundry Machinery Co.
Chairman, Publicity Committee

THE LOCAL CHAPTERS of A.F.A. and ASM held a joint meeting on December 11 at the Hotel Seneca, Rochester, N. Y. Nearly 150 members of the two groups heard Dr. Ralph Lee, General Motors Corp., Detroit, give an inspiring address on "Humanics in the Foundry." His talk was built around his extensive studies of human nature and human characteristics. This furnished a good amount of wit and humor, and plenty of food for thought. Human beings, like metals and alloys, have their own characteristics and the necessary heat treatment, or method of handling, to develop the best in physical properties varies with the individual, the speaker finds. For harmony and success in business these individual and group characteristics must be considered if we are to have proper employer-employee relations, he said.

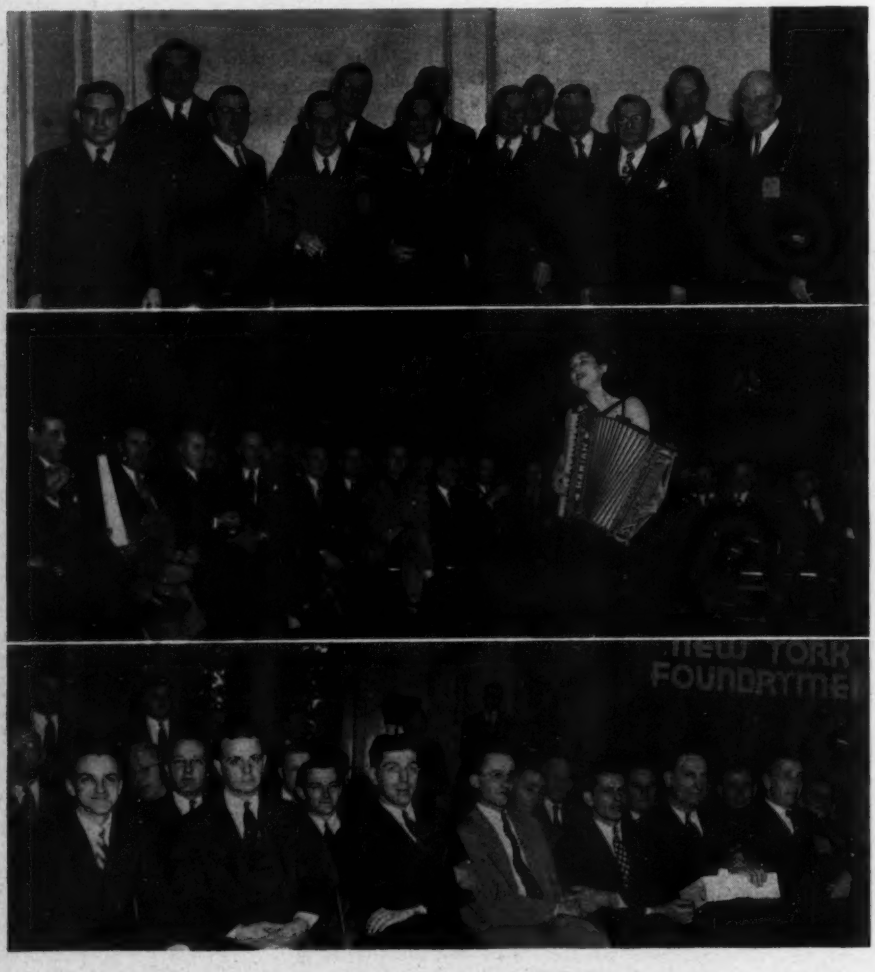
Metropolitan

J. A. Bukowski,
Worthington Pump & Machinery Corp.
Chapter Reporter

THE ANNUAL CHRISTMAS party of the Metropolitan chapter was held December 7 at the Essex House, Newark, N. J. Approximately 450 members and guests were present at the dinner and for the floor show.

Chicago

THE CHICAGO CHAPTER has elected a new vice-chairman to succeed Frank E. Wartgow, who recently joined the National A.F.A. staff. Mr. Wartgow's successor is L. H. Hahn, Sivyer Steel Casting Co., Chicago. Two new directors, A. W. Gregg, Whiting Corp., Harvey, Ill., and Oscar Blohm, Hills-McCanna Co., Chicago, were elected to fill the vacancies left by Board Members L. H. Hahn and, Dr. R. F. Thomson, Dodge Chicago plant, Chrysler Corp.



The Christmas party sponsored by the Central New York chapter was appreciated by all who attended—as is evidenced by the broad smiles on the faces in these pictures.

Central New York

John A. Feola,
Crouse-Hinds Co.
Chapter Reporter

DECEMBER 15 the Central New York chapter held its annual Christmas party in the ballroom of the Onondaga Hotel, Syracuse, N. Y. The two hundred and twenty-five members and guests enjoyed the evening's program, consisting of dinner and entertainment.

Chapter Chairman E. G. White, Crouse-Hinds Co., Syracuse, N. Y., opened the festivities by welcoming the members, guests and visitors from neighboring chapters.

J. F. Livingston, Crouse-Hinds Co., was the party chairman and did a fine job in presenting this successful affair.

Twin City

Paul Hesse,
Union Brass & Metal Mfg. Co.
Chapter Reporter

NATIONAL PRESIDENT Fred J. Walls, International Nickel Co., Detroit, was the speaker at the December meeting of the Twin City chapter. He was introduced by S. V. Wood, Minneapolis Electric Steel Castings Co., and National Vice-President who also spoke on youth encouragement as did N. F. Hindle, director, A.F.A. Technical Development Program, Chicago.

Mr. Walls' presentation emphasized the fact that the metal castings industry is faced by a lack of trained manpower, which will prevent the industry from discharging its reconversion duties. Lack of public understanding of foundry work was given as the primary cause of the manpower shortage. A program was suggested by Mr. Walls that would attract workers to the foundry industry. Included in the program would be public relations activities, such as talks before groups and on

(Continued on page 98)

ABSTRACTS

NOTE: The following references to articles dealing with the many phases of the foundry industry, have been prepared by the staff of *American Foundryman*, from current technical and trade publications.

When copies of the complete articles are desired, photostat copies may be obtained from the Engineering Societies Library, 29 W. 39th St., New York, N. Y.

Bearing Metals

TIN CONSERVATION. *"New Bearing Alloy Conserves Tin,"* THE IRON AGE, November 29, 1945, vol. 156, no. 22, pp. 64-65.

Description of the development of a copper-nickel-antimony alloy and a comparison of its properties with those of 80-10-10 alloy.

Casting Methods

PERMANENT MOLD. Basch, D., *"Metal Mold Castings,"* METAL PROGRESS, October, 1945, vol. 48, no. 4, pp. 761-768.

Metal mold castings include permanent mold castings, semi-permanent mold castings, die castings, and centrifugal castings. General advantages of all of these over sand castings are higher strength, better surface appearance, and closer tolerances. However, the tooling costs are higher. Whether one of these methods should be used in preference to sand casting depends on the suitability of the material considered and how it is affected by the process, competitive and advertising advantages, cost of tools and cost of finished piece (including machining), total savings in cost during a liquidating period, and savings in machine-hours, man-hours, and scarce materials.

The author describes each of the metal-mold casting processes and discusses their applications.

PLASTER. Barnard, N. B., *"Plaster Mold Castings,"* MATERIALS AND METHODS, October, 1945, vol. 22, no. 4, pp. 1085-1089.

A sketchy description of one of the methods of making plaster mold castings and a discussion of the advantages and limitations of this method.

Chemical Analysis

ALUMINUM IN STEEL. Spiers, Robert, Fischer, Philip, and Proctor, Kenneth L., *"Spectrochemical Determination of Small Amounts of Aluminum in Steel,"* IND. & ENG. CHEM., ANAL. ED., December, 1945, vol. 17, no. 12, pp. 772-774.

A method is described for the determination of aluminum in steels in the range of 20 to 500 micrograms per sample. Preceded by a mercury cathode separation of aluminum, the analysis is completed with standard spectrographic equipment. Because of the prevalence of aluminum, all reagents and the electrodes must be checked. Work is proceeding on the determination of zirconium by the same method.

COMBINED ANALYSES. Weissler, Alfred, *"Simultaneous Spectrophotometric Determination of Titanium, Vanadium, and Molybdenum,"* IND. & ENG. CHEM., ANAL. ED., November, 1945, vol. 17, no. 11, pp. 695-698. Also *"Spectrophotometric Determination of Titanium in Steels,"* December, 1945, vol. 17, no. 12, pp. 775-777.

Using the hydrogen peroxide complexes of titanium, vanadium and molybdenum in perchloric acid solution, the author shows how the three elements may be determined simultaneously in solution. This is done by measuring the optical densities of the solution at wave lengths corresponding to the absorption peaks of the three complexes. The experimental work was done on specially prepared samples rather than alloys.

Continuing the work described in the first article, Mr. Weissler has devised an improved rapid accurate method for the determination of titanium and vanadium in iron, steel, vanadium steel, and stainless steel. A separation of titanium or the use of hydrofluoric acid are not required. The determination of metallic and combined titanium in steel is also reported.

FOUNDRY CONTROL METHOD FOR COPPER. Clardy, Frederick B., Edwards, John C., and Leavitt, John L., *"Rapid Method for Determination of Copper in Steel,"* IND. & ENG. CHEM., ANAL. ED., December, 1945, vol. 17, no. 12, pp. 791-792.

Precipitation of cuprous thiocyanate from a perchloric acid solution, followed by a modified iodate titration, enables the analyst to determine copper in carbon and alloy steels in 15 minutes. Requiring no special equipment, results within plus/minus 0.02 per cent are readily obtained.

NICKEL IN STEEL. West, Philip W., and Dean, James F., *"Polarographic Determination of Nickel in Steel and Nickel Ore,"* INDUSTRIAL AND ENGINEERING CHEMISTRY, ANALYTICAL EDITION, November, 1945, vol. 17, no. 11, pp. 686-687.

A polarographic method of analysis is described which is simple, rapid, and as accurate as the more lengthy gravimetric procedures commonly used. More accurate than spectrographic methods, the cost of the equipment is much less than that required for spectrographic analysis.

RAPID CARBON DETERMINATION. Stanley, J. K., and Yensen, T. D., *"Rapid Method of Determining Minute Quantities of Carbon in Metals,"* IND. & ENG. CHEM., ANAL. ED., November, 1945, vol. 17, no. 11, pp. 699-702.

A rapid accurate analysis of low carbon alloys, requiring only 20 minutes, is described. Developing new apparatus, the authors are able to determine carbon in amounts less than 0.01 per cent with an accuracy of plus/minus 0.0005 per cent. The method can be used for unalloyed iron, carbon steels, iron-silicon alloys, iron-alumin alloys, pure nickel and chromium-nickel alloys.

Cupola Practice

MELTING MECHANISM. Rambush, N. E., and Taylor, G. B., *"A New Method of Investigating the Behavior of Charge Material in an Iron-Foundry Cupola and Some Results Obtained,"* FOUNDRY TRADE JOURNAL, November 8, 1945, vol. 77, no. 1525, pp. 197-204, 212.

In order to investigate the physical changes which take place within a cupola, the authors developed a method of water quenching a fully-charged cupola, thus rapidly checking operations, and studied the contents of the charge, layer by layer.

Specially marked pieces of steel plate were placed at specific positions within each charge. The path of their progress through the cupola was noted, and chemical analyses were made in order to study the chemical reactions which occurred.

It was found that the relative position of materials as charged was not maintained during descent of the charge. The shape and size of metallic pieces influenced the path which they followed. The size of coke was reduced as it descended in the furnace. Reduction was not uniform throughout a horizontal plane, however.

The slag ledge which formed along the tuyere level altered the path of flow through the furnace as the ledge increased in size.

It was found that the steel bars absorbed carbon very slightly as they descended through the furnace until melting began, and this carbon was chiefly on the surface of the piece. Carbon absorption became much more rapid as the steel started to melt. Some of the carbon picked up remained in a graphitic state. On first descending the surface of the steel picked up sulphur but seemed to lose it again as the charge descended further.

Employment

GOOD HOUSEKEEPING. Jones, William, *"The Modern Specialized Foundry,"* FOUNDRY TRADE JOURNAL, Oct. 18, 1945, vol. 77, no. 1522, pp. 135-138, 142.

A discussion of changes which must be made within foundries in order to attract young men to the foundry industry.

Heat Treatment

FURNACE ATMOSPHERES. Mott, J. R., *"Modern Heat Treatment of Ferrous Materials,"* CANADIAN METALS AND METALLURGICAL INDUSTRIES, Nov., 1945, vol. 8, no. 11, pp. 26-28.

During any kind of heat treatment, the surrounding atmosphere nearly al-

(Continued on Page 92)

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NOTE

*"Proper Melting Decreases Foundry Losses," contains interesting data. Also, the booklet, "Nonferrous Ingot Metals of Today." Write for both of these. They are free.

Successful foundrymen deoxidize or "clean up" molten metal by a scientific method worth using *as indicated:*

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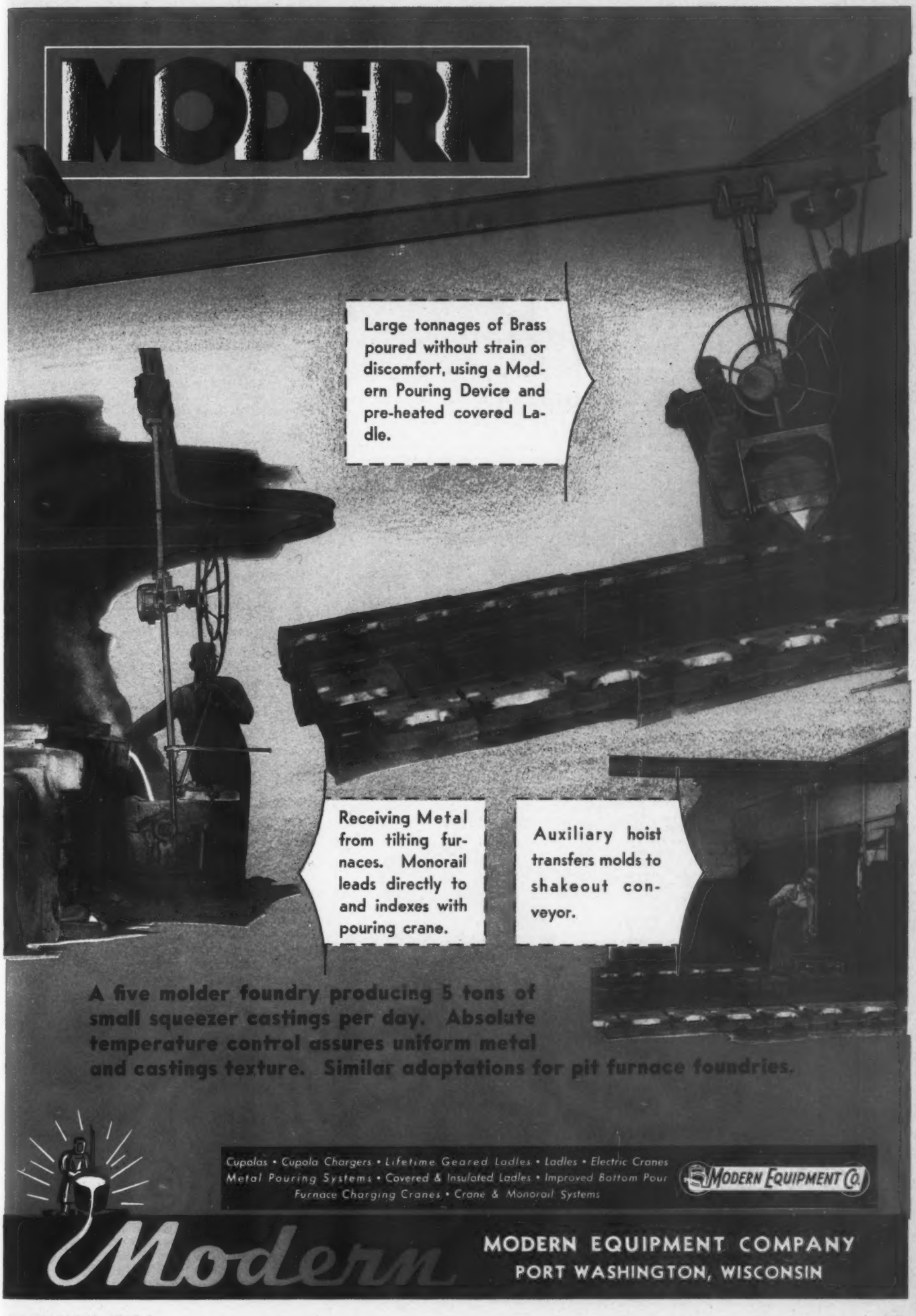
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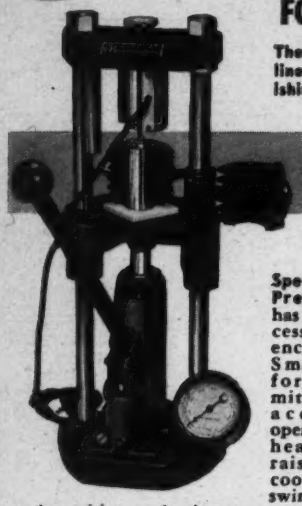
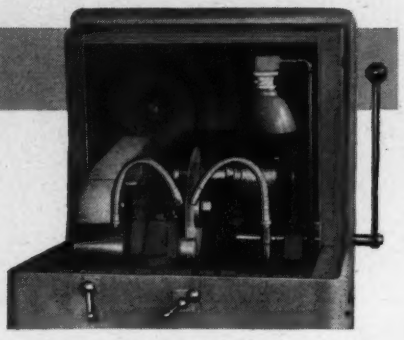
The items illustrated are selected from the complete Buehler line of equipment, tools and accessories for molding and finishing specimen mounts.



Specimen Mount Press No. 1315 has complete accessibility, no enclosed parts. Smooth performance permits speed and accuracy in operation. Solid heater can be raised and the cooling blocks swing into position without releasing pressure on the mold. This rapid cooling permits production of transoptic mounts in a few minutes. Shipping weight, 100 lbs.



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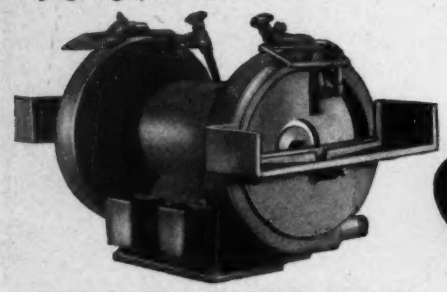

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ABSTRACTS

(Continued from Page 89)

ways either carburizes or decarburizes the surface of any ferrous part being heat treated. The most vital factors in controlling surface reactions are the ratios carbon dioxide to carbon monoxide and water to hydrogen. These ratios, known as critical ratios, change with temperature. Hence, it is extremely difficult to maintain an exact balance between carburizing and decarburizing conditions.

MALLEABLIZING. *(See Malleable Cast Iron.)*

Magnesium-Base Alloys

CHEMICAL ANALYSIS. Wood, C. H., *"The Volumetric Determination of Aluminum in Magnesium Alloys,"* MAGNESIUM REVIEW AND ABSTRACTS, April, 1945, vol. 5, no. 2, pp. 31-37.

"An alkalimetric titration method has been developed for the determination of aluminum in magnesium alloys. The excess of free acid in a solution of the alloy is neutralized with sodium hydroxide solution using a screened indicator and the aluminum is then determined, using a second indicator, by titration of the equivalent amount of acid liberated by the addition of sodium citrate. The only interfering metal in the aluminum-containing "Elektron" alloys is manganese, but a simple correction can be applied."

FATIGUE STRENGTH. Fox, F. A., and Walker, J. L., *"The Fatigue Strengths of Four Aluminum-containing Magnesium-Base Casting Alloys,"* MAGNESIUM REVIEW AND ABSTRACTS, Oct., 1944, vol. 4, no. 4, pp. 105-114.

The authors' present numerical data comparing the fatigue strengths of four types of magnesium-base alloys in the as-cast and all heat treated conditions in which the alloys are used.

FOUNDRY PRACTICE. Moss, W. Wade, Jr., *"Silico-Fluorides and Compound Inhibitors in Magnesium Casting,"* LIGHT METAL AGE, August, 1945, vol. 3, no. 8, pp. 21-28, 31-32, 49.

The concluding of two articles about the production of sound magnesium castings. This article considers mold preparation, gating and risering, control of oxide films, chills, gassy metal, microporosity, shrinkage, hot shortness, misruns, melting and fluxing, and control of magnesium hazards.

IMPACT AND SLOW BEND STRENGTHS. Fox, F. A., and Walker, J. L., *"The Impact and Slow Bend Strengths of Magnesium Casting Alloys,"* MAGNESIUM REVIEW AND ABSTRACTS, Jan., 1945, vol. 5, no. 1, pp. 3-9.

A presentation of numerical data obtained from impact tests of four representative alloys: Elektron AZ91, Elektron A8, Dow H, and Dow C.

MICROPOROSITY. Baker, W. A., *"Microporosity in Magnesium Alloy Castings,"* CANADIAN METALS AND METALLURGICAL INDUSTRIES, October, 1945, vol. 8, no. 10, pp. 37-38, 40.

Condensed from a paper published in the *Journal of the Institute of Metals,* vol. LXXI, p. 165 (1945).

The most important consideration which can be varied in the control of microporosity is the production and maintenance of a steep temperature gradient from feeders to remote parts of

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ABSTRACTS

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the castings. Factors which can be varied to achieve this temperature gradient are the method of pouring, pouring speed, and pouring and mold temperatures.

How these factors may be varied to control the temperature gradient is discussed by the author.

MICROPOROSITY. Liddiard, E. A. G., and Baker, W. A., *"The Cause and Control of Microporosity in Magnesium Alloys,"* FOUNDRY TRADE JOURNAL, Oct. 25, 1945, vol. 77, no. 1523, pp. 155-161; Nov. 1, 1945, vol. 77, no. 1524, pp. 173-179.

"The form and distribution of porosity in magnesium base alloy castings solidified under controlled conditions have been studied and some comparative tests made on aluminum base alloys of similar constitution. It is concluded (1) that the characteristic microporosity in magnesium alloys is due essentially to unfed shrinkage in alloys which solidify over a temperature range; (2) that the presence of gas in magnesium base alloys causes a marked increase in the amount of microporosity in the casting and does not alter its characteristic form; (3) that owing to their low heat capacity and relatively rapid solidification the temperature distribution in many magnesium alloy castings tends to be less favorable to progressive feeding; and (4) that under the same solidification conditions, the strength of unfed castings in magnesium and aluminum alloys is affected to the same extent, but that it is more difficult to ensure correct solidification conditions in magnesium than in aluminum alloys.

"Foundry technique must be such that the metal is free from gas initially and does not pick up gas by reaction with overheated sand. Running, pouring and gating conditions must be adjusted to ensure progressive solidification from the important parts of the casting towards the risers and feeders."

PROPERTIES. Walker, J. L., *"An Examination of the Possible Correlation of Hardness and Tensile Strength of Magnesium and Its Alloys,"* MAGNESIUM REVIEW AND ABSTRACTS, April, 1945, vol. 5, no. 2, pp. 38-46.

A graphical presentation of the results of a study of the relationship between hardness and tensile strength of magnesium alloys.

After the study was completed, it was concluded that no broad technically useful relation exists between the hardness and tensile strength of magnesium-base alloys. The hardness of the alloys is related to the aluminum content. To some extent it is dependent on the condition of the alloy, but not sufficiently so to serve as an indication of structure. It was found to be desirable to use high loads for hardness tests on cast magnesium alloys.

SPECTROGRAPHIC ANALYSIS. Wood, C. H., *"The Spectrographic Determination of Calcium in the Presence of Large Quantities of Magnesium,"* MAGNESIUM REVIEW AND ABSTRACTS, Jan., 1945, vol. 5, no. 1, pp. 10-17.

The chemist finds it difficult to accurately determine calcium in the presence of much magnesium by means of chemical analyses. However, the Scheibe solution method gives satisfactory results. This is a spectrographic method in which dissolved substances are absorbed as porous electrodes which are arced under selected conditions.

Malleable Cast Iron

MALLEABLIZING. Fallon, J., *"Malleablizing Iron Castings,"* FOUNDRY TRADE JOURNAL, September 20, 1945, vol. 77, no. 1518, pp. 53-56.

A description of the advantages which result from the use of a sealed radiant tube bell furnaces for malleablizing.

Among the advantages listed are that the malleable iron castings create their own protective atmosphere and prevent scaling during annealing; the furnace operation is flexible, permitting the handling of a great range of compositions; packing materials and annealing pans are not needed; and the furnace provides facilities for the rapid air-quench, equalization, and progressive slow cooling under absolute control.

Pouring

RECOMMENDATIONS. Wessel, Carl, *"Pouring Light Metals,"* LIGHT METAL AGE, September, 1945, vol. 3, no. 9, pp. 17, 34.

The author calls attention to the way in which metal flow, as a result of pouring procedures, affects the soundness of an aluminum bronze casting. However, his description and recommendations are applicable to nearly all casting alloys to a greater or lesser degree.

Most casting defects traceable to pouring technique are the results of turbulence. Design of gating systems, pouring temperatures, and pouring techniques can be used to control turbulence. In general

(Abstracts concluded on Page 101)

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CHAPTER ACTIVITIES

(Continued from Page 88)

the radio, motion pictures, literature on casting processes and the importance of metal castings, and public trips through foundries. The training of prospective foundrymen also has an important place in the program, Mr. Walls said. Foundry practice and instruction should be promoted in high school manual training classes and in trade school courses.

Saginaw Valley

J. J. Clark,
Saginaw Malleable Iron Div.,
General Motors Corp.
Chapter Reporter

PRINCIPAL SPEAKER at the December meeting of the Saginaw Valley chapter, held December 6 at Frankenmuth, Mich., was H. E. Baughman, Wheeling Steel Corp., Portsmouth, Ohio.

In dealing with the topic "Coke and By-Products," Mr. Baughman first discussed the selection, sizing and blending of the coals prior to coking. Test methods and equipment for determining the coking characteristics of various coals were described.

A diagrammatic chart was used in describing the processes and products of a modern by-product coke plant. The speaker stated that approximately 60 per cent of the gas produced in the process is used for heating the retorts. He stated that, contrary to opinion, the production of coke, not by-products, is the prime objective and source of revenue for the coke plant.

Mr. Baughman stressed the importance of selecting the proper size coke for a given size cupola and the importance of care in handling the coke after receiving it to avoid breaking it into smaller sizes. In speaking of cupola operation he pointed out the desirability of controlling the weight of air used and its moisture content to obtain uniformity in iron analysis and characteristics at all times.

Many troubles with cupola iron are the result of using the cupola as an intermittent melting unit to be shut down or started up to take care of all difficulties in the molding

(Chapter Activities concluded on Page 99)

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CHAPTER ACTIVITIES

(Continued from Page 98)

department. The speaker emphasized the fact that best results from cupolas are obtained by keeping tuyeres clean and maintaining a steady blast.

Wisconsin

JUST OFF THE PRESS is the directory and program of the Wisconsin chapter. This small booklet contains a history of the local chapter, names of chapter and National officers and directors, chapter by-laws, chapter program and a complete list of the chapter committee personnel. Also there is a comprehensive list of all members, compiled according to their membership affiliation.

Michiana

H. B. Voorhees,
Dodge Mfg. Co.
Co-Chairman, Entertainment Committee

A THOROUGH EXPLANATION of the work being accomplished by the A. F. A. Committee on Analysis of Casting Defects was explained by A. S. Klopf, Lester B. Knight & Associates, Chicago, before the December 4 meeting of the Michiana chapter. Gathering at the La Salle Hotel, South Bend, Ind., the membership heard this speaker, who is a member of the above committee, discuss "Casting Defects."

Mr. Klopf showed a number of interesting slides and presented a constructive lecture on a subject of vital importance to all foundrymen.

Chicago

L. C. Smith,
Peninsular Grinding Wheel Co.
Chapter Secretary

CHICAGO CHAPTER TREASURER, B. L. Simpson, National Engineering Co., Chicago, told the history of the castings industry to over 200 members and guests of the Chicago chapter assembled at the Chicago Bar Association, December 3.

Mr. Simpson's talk was amply illustrated as he traced the casting of metals from early primitive methods to present-day scientific foundry practice.

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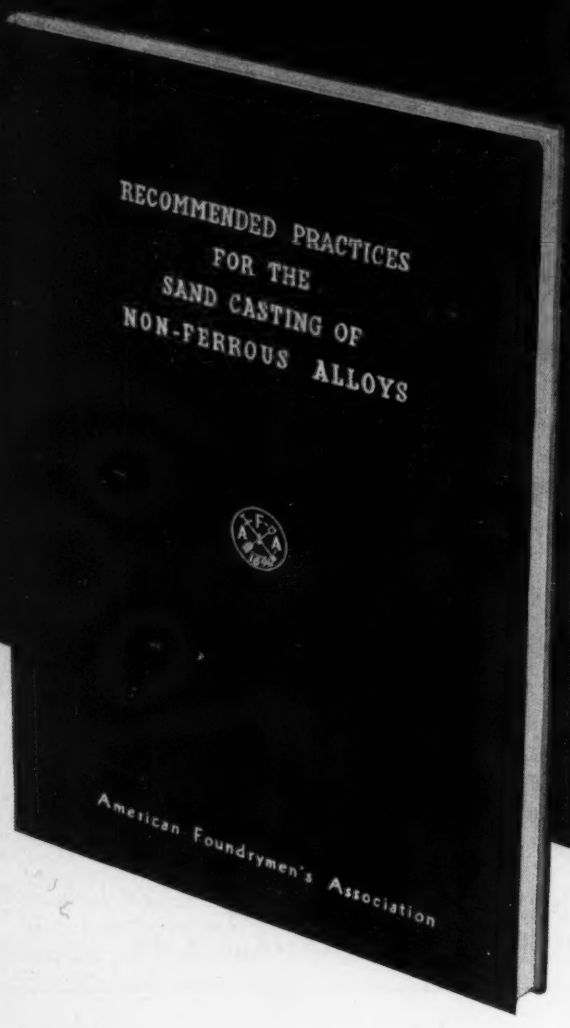

Information contained in this important New A.F.A. publication has been compiled by the Recommended Practices Committee of the A.F.A. Brass and Bronze Division, and the Committees on Sand Casting of the A.F.A. Aluminum and Magnesium Division. A book that provides non-ferrous foundrymen with accurate, up-to-date data for the production of practically any non-ferrous alloy casting, and enables them to check present production practices against accepted standards and wide experience. An indispensable reference work wherever non-ferrous metals are cast . . . compiled by many leading foundrymen and metallurgists. Contains 159 pages, 42 tables, 35 illustrations; cloth bound.

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High-Lead Tin Bronze.
Leaded Nickel Brass and Bronze Alloys (Silicon Bronze).
Aluminum Bronze.
Aluminum-Base Alloys.
Magnesium-Base Alloys.

ABSTRACTS

(Continued from Page 97)

high pouring temperatures aggravate many of the causes of casting defects while low pouring temperatures lessen the occurrence of pouring defects. (This does not, of course, mean that pouring temperatures can be so low that the casting will not run.)

Radiography

PURCHASING STANDARDS. Ball, Leslie W., *"X-ray Standards for Purchasing Castings,"* THE IRON AGE, November 22, 1945, vol. 156, no. 21, pp. 62-64.

Much can be accomplished in establishing X-ray acceptance standards for castings. A satisfactory basis for acceptance can be arrived at if the casting is divided into critical and non-critical sections and the size of defect which will be permitted in each section clearly described. Standards for non-critical sections of a casting can be less rigorous than standards for critical sections.

Steel

HIGH TENSILE. West, W., Hodgson, C. C., and Waring, H. O., *"High Tensile Steel for Castings,"* FOUNDRY TRADE JOURNAL, Sept. 20, 1945, vol. 77, no. 1518, pp. 47-52; Sept. 27, 1945, vol. 77, no. 1519, pp. 69-76, 80; Oct. 4, 1945, vol. 77, no. 1520, pp. 101-104.

The authors discuss a number of factors pertinent to the making of high tensile steel. The steels they worked with were carbon manganese steels containing small amounts of residual alloys, nonstandard steels containing larger amounts of residuals, and 2½ per cent nickel-chromium-molybdenum steels. The steels were made in basic-lined electric-arc furnaces with conducting hearths.

Points the authors have considered include steel-making practice; hydrogen in steel; the rise of aluminum additions to control adherent grain size; the control of sulphide distribution; temperature measuring; relationship between type of primary structure and mechanical properties; heat treatment; mechanical properties; chemical composition; molding sands; core sands; risering; and x-ray inspection.

PROPERTIES. *"Engineering Properties of Steel Castings,"* Engineering File Facts Number 91, METALS AND ALLOYS, September, 1945, vol. 22, no. 3, pp. 771, 773.

A compact presentation of types of cast steel, heat treatment, and design notes for steel castings.

Included is a tabulation of specifications for cast steel.

THERMIT MELTING. Brown, R. T., *"Thermit Casting Technique,"* STEEL, September 3, 1945, vol. 117, no. 10, pp. 134, 137, 188, 190.

When conventional steel melting equipment is not available for the casting of a repair part, molten steel may be produced by a process which utilizes the thermit reaction. Once the metal is molten, about the only difference between conventional castings techniques and the thermit casting technique is that the metal must be allowed to cool down several hundred degrees, since an excess of heat is generated by the thermit reaction.

The author describes the entire process and recommends sand mixtures which may be suitable for making the mold.

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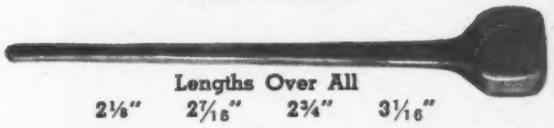

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